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ART. XXXV.—*Observations upon the Practicability of reaching the North Pole*—with a map; by ISAAC I. HAYES, M.D.

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I VENTURE to trespass upon the time of the Association for the purpose of directing attention to a profitable field of scientific inquiry.

The announcement made by Dr. Kane of the discovery of an open sea within the Arctic ocean, was received by the scientific world with many regrets that circumstances had not afforded an opportunity for a further investigation of the subject. The phenomenon was witnessed at the most remote point reached by his exploring parties, and at a period of the cruise too late to admit of further effort. I wish to call attention to the facilities for doing what could not then be done—for continuing the explorations begun by American citizens upon the most northern lands of our planet. It is for this purpose that I have appeared before this representative body of American science.

Arctic geography has been slowly developed; and while wonderful revelations have been made every year in the torrid and temperate latitudes, until scarcely a square mile of the earth's surface within those limits remains untraversed by the explorer; while time after time the earth has been circumnavigated, the Poles, about which the whole fabric revolves, are enveloped in mystery.

The northern coasts of Asia, Europe and America, have been determined with reliable accuracy; but whether the Russians are correct in their belief in the existence of a great continent lying to the northward of Asia, or whether the Archipelago to the northward of America continues even to the Pole, we do not know; yet, while in the arbitrary divisions of the aqueous portions of the earth's surface, the "Arctic ocean," embraces the watery area within the parallel 66° 33′, we may, I think, safely suppose that, throughout the greater part of the actual coast line circumference of this great Mediterranean basin, we have determined the polar land limit. Of the continental masses of land, any portion of which has hitherto come within the range of exploration, the only one remaining unknown upon its northern face is that of Greenland, and by referring to the rude diagram which I have projected for the inspection of members, it will be seen, that this continent, with the adjacent land of Grinnell to the westward, continuing as already observed farther towards the Pole than any other upon our globe, gives us the most central position for exploration.

I need hardly say that the great difficulty which has been encountered by all navigators who have attempted to penetrate within the polar basin, whether for the accomplishment of the northwest, or the northeast passage, or to reach the Pole, has been the great *ice barrier*, which invests with an irregular line the entire area, and extends in the western Atlantic considerably to the south.

Although the position and movements of this ice barrier are well known to the members—having been so frequently defined—I have nevertheless thought it necessary briefly to sketch its outline.

It is sometimes brought by the great polar current of the Greenland sea and Davis' Strait, as low as the forty-eighth parallel of north latitude off Newfoundland. Continuing thence parallel with the Labrador coast to the sixty-fourth or sixty-sixth degree, its outline forms a bight in Davis' Strait, conformable with the remarkable curve of the Greenland current; thence along the coast southward, it rounds Cape Farewell, and springing over the Greenland sea to Nova Zembla, it invests sometimes Iceland and Jan Mayen; thence eastward along the coast of Asia, it joins America over the Strait of Behring; and still following closely the tortuosities of the shore line, it dips down into Hudson's Bay.

The area invested by this irregular ice coast-line, is not far from six millions (6,000,000) of square miles.

This is not, however, one continuous ice margin, but its southern edge presents a broken outline, penetrable at many points; and through the partial openings caused by currents, tides,

storms, and changes of season, the Pole has been approached from several different quarters. The northern edge which has hitherto appeared as a solid and impenetrable barrier, is much less irregular than the other, and its outline invests a much smaller area. In the line of Baffin's Bay it is not reached until we have advanced nearly two thousand miles to the northward of the point, where the ragged border of the drifting ice presents the first obstruction to free navigation. Dr. Kane was arrested by it in Smith's Strait, in latitude 78° 37′. Scoresby in the whale ship Baffin penetrated in 1822 to the east coast of Greenland, through the broken belt of the polar current, but his northward progress was stopped by an unbroken field, commencing at Gaal Hamke's Land, latitude 75°, and stretching east and north to the regions above Spitzbergen. To the northward of Spitzbergen we lose its continuity, and the conflicting reports of the early Dutch navigators leave us in doubt as to the actual position of the impenetrable barrier. There can be no doubt, however, but that the closest approaches to the Pole by water have been made through this remarkable indentation, known of old as the "Fisherman's Bight." To the eastward of Spitzbergen we meet the solid barrier resting on the northern face of Nova Zembla—about latitude 77°—where it was met by Barentz and others of the earlier navigators; and eastward again from Nova Zembla it follows so closely the trend of the shore that the Russian navigators and traders have been able to accomplish but little more than a slow and precarious passage through the varying channels which, during the summer, separate the coast lines of the ice and land. Above Behring's Strait, Cook, Kellet, and Rogers were checked at latitudes 70° 45′, 72° 51′, and about 73° respectively, and Sir Robert McClure, following the line of the coast eastward from Icy Cape, found an impenetrable barrier continuous to the north coast of Bank's Land. Parry could neither pass to the west nor to the north of Melville Island, and Sir Edward Belcher was arrested in the Queen's Channel, in latitude 76° 52′.

The area invested by a line intersecting these several points of extreme navigation would equal about three millions (3,000,000) of square miles.

Whether this extensive area is a uniform sea of ice—as it has appeared from whatever point observed—has been a fruitful source of conjecture. We were almost wholly wanting in positive knowledge until the present century.

Failing in every effort to penetrate to the centre of the polar basin by water, and discouraged by the fruitless attempts of Baffin, Hudson, Poole, Phipps, and others, it was determined to alter the plan of operations, and boldly push out with sleds upon the frozen sea. From four several points such efforts have been made—by the Russians from the Kolyma and Jana; by the

English from Spitzbergen; and by the Americans through Smith's Strait.

The lead was taken by the Russians. In 1810 Hedenström and Pschenizyn started from the mouth of the Jana with the dog sledges of the native Samoides, in search of a continent supposed to lie to the northward. Ten years later they were followed by Anjou and Wrangel, who were dispatched by the Russian government for the solution of the same interesting geographical problem. The ice over which these several parties travelled was found mostly smooth, both in the outward and return passage, but their northward progress was checked by their coming suddenly upon open water—"a vast immeasurable ocean," as described by Admiral Wrangel—to the northward of Ketelnoi, stretching eastward in the direction of Cape Schelagskoi. The time of observation was the cold months of February, March, and April.

A similar attempt was made from Spitzbergen in 1827, by Sir Edward Parry, using boat sledges and men, instead of dogs, for draught. Parry was carried by the Hecla to Hakluyt Headland on the northern side of the island, and starting upon the solid ice from the Rocks, known as the "Seven Islands of Spitzbergen," a little above the 80th parallel, he made his descent in a due north line. Reaching to latitude 82° 45′, he discovered the whole body of the ice upon which he travelled to be drifting southward, and finding that he was losing ground he was forced to return.

The attempt of Dr. Kane to penetrate to an "open Polar Sea," was made from a point nearly upon an opposite meridian from the line of descent of Hedenström and Wrangel. Like the Russians, he used the dog sledges of the natives. Having been arrested with his vessel by the solid field ice, as already observed, he passed the winter of 1853–'54 at Rensselaer Harbor, in latitude 78° 37′, and early in the spring commenced his sledge operations. The first parties failed in consequence of the roughness of the ice and want of provisions, to reach beyond latitude 80°; but later in the season, a final and more successful effort was made by William Morton and Hans Hendrick, an Esquimaux hunter. Early in June they left the brig with a single team of seven dogs, and replenishing their stock of provisions at a *cache* establishment near the base of Humboldt Glacier, in latitude 79° 12′, they made from this point a final start. After encountering more than the usual share of difficulties and dangers peculiar to ice travel, all of which were overcome with manly energy and determination, they entered on the 20th a new channel opening nearly due north from the N. W. angle of Smith's Strait. This channel, which now bears the honored name of that Secre-

tary of the Navy,* who, obedient to the dictates of patriotism, humanity, and gallantry, gave all the weight of his official position and personal influence toward the organization of the expedition, was found open from latitude 80° 20′ to 81° 15′, the extreme limit of exploration. Here, from an elevation of about four hundred feet, Morton looked out to the northward upon a boundless, iceless sea.

Although these several explorations cover only a comparatively small area, yet their results are harmonious, and point quite clearly to this result viz.: that there is an open sea within the boundaries of the sea barrier as already delineated—a watery area encircled by a belt or zone of ice. That this is the case in summer, there can, I think, be no doubt.

Viewed alone, however, the discovery of those open spaces would indicate nothing. The open area of Dr. Kane did not exceed four thousand (4,000) square miles. That seen by the Russians was at no time as great. Parry did not reach to open water at all, and its existence to the northward of his terminus is only conjectured from the fact that the whole body of the ice upon which he travelled was moving from the Pole. But the many observations made in important localities, give, when viewed together, a positive value to the results separately reported by the explorers. A multitude of causes, local and accidental, might operate to produce the result of open water as above noted; but water seen as a part of a great open polar sea, stands toward other observed phenomena, in the relation of cause and effect.

These observations I have thought of sufficient importance to dwell upon at considerable length.

I will first call attention to the bird-life. Morton reports having seen the cliffs, sea and air, about the open water of Kennedy channel, literally swarming with Brant geese (*Anas Bernicla*), Eider ducks (*Somateria mollissima*), and the Fulmer (*Procellaria glacialis*), and glaucous and tridactyl gulls. Sea swallows (*Sterna Arctica*), dovekies (*Uria Grylle*), and other varieties of waterfowl, easily recognized as familiar friends of other days in Baffin's Bay, crowded the rocky shores and cliffs of the expanding strait. Representatives of these same families have been observed flying northward in the spring from almost every quarter; at Nishne Kolymsk, at Koola, in Lapland, at the mouths of the Mackenzie and Coppermine, and at intermediate points. At Rensselaer Harbor and other stations within Smith's Strait I have seen large flocks flying in the same direction. These birds migrate north to bring forth their young. They are essentially marine, since they draw their subsistence entirely from the ocean, feeding mainly upon *molluscan* and *crustacean* life. Their

* Hon. John P. Kennedy.

breeding places are hence selected where instinct directs to open water.

We are wanting in any connected series of observations beyond a certain line which will give us conclusive results as to the climate about the Pole, but there are many isolated facts which point to considerable modification of temperature, as we pass beyond a point, not yet determined with positive, although within reasonable limits. If it can be shown, as has been assumed, that a milder climate exists at the Pole than a few degrees farther to the south, it must be mainly owing to the influence of open water; if not permanent nor uniform, at least to a greater degree, and for a longer annual period, than further to the south, for an ice covered sea would have all the frigorific effect of a solid body of land.

That a milder climate does exist at the Pole than a little farther south, is clearly shown, or at least strongly indicated, by the isothermal curves, which bend up over the Greenland sea and Behring's Strait, exhibiting a disposition to join together from either side, and to revolve around two centres—one above Siberia, the other above America—giving us the same temperature at latitude 90° as at the arctic circle. Sir David Brewster, when establishing his centres of cold and magnetism, used as a basis the isotherms of Baron Humboldt—which cease at 32° of Fahrenheit's scale—and the material principally of Giesecke, Parry, Erman, and Wrangel, placing them upon latitude 80°, giving them the temperature of zero. Subsequent observations, and many of them of very recent date, in the hands of such able philosophers as Kupffer, Berghaus, Prof. Dove, Capt. Duperrey, and others, have brought these points of maximum cold and magnetic intensity nearer to the continents, and although not yet accurately determined, they have doubtless movable centres near the crossing of the 78th parallel of latitude with the 95th meridian of western and the 120th of eastern longitude.

That the first named of these positions is not far from the true American Pole of cold is shown by the elaborate isothermal charts of Baffin's Bay and vicinity, projected by Chas. A. Schott, Esq., of the U. S. Coast Survey.

An observation, valuable in this connection, will be found recorded in the able report of Mr. Durand upon the Floral Collections of Dr. Kane's Arctic Cruises, published in the Journal of the Academy of Natural Sciences for 1856. By an examination of this report it will be seen that two plants (*Hesperis Pallasii* and *Vesicaria Arctica*) were brought from the lands lying to the northward of the Humboldt Glacier, latitude 81°. These plants do not appear either in the collections made by Dr. Kane during his first voyage, or by myself during his second, farther south upon the Greenland coast. The first named was found by its discoverer, Pallas,

in Russian America, and, by the authority of Hooker, we meet with it upon the same isothermal curve in Labrador. It has not been discovered in the cold zone lying between Labrador and Washington Land, from the 60th to the 80th parallel, either on the Greenland or American side of Baffin's Bay.

The migrations of human life, also, furnish us valuable data. The traditions of the Esquimaux point to the north as the central home of the race. Erasmus Yorke spoke of his mother having come from the north, and when Sacheuse told the inhabitants of Prince Regent's Inlet that he came from the south, they replied that it was impossible, since in that direction there was nothing but ice. Egede and Crantz both assign to the Esquimaux a northern origin, and the inhabitants of Smith's Strait have repeatedly told me of the day when their forefathers used to hunt the reindeer and the musk ox—the *Tooktook* and the *Oomeak*—far away to the northward. These traditions would seem to be borne out by positive observations. The remains of their old encampments are found along the east shore of Smith's Strait, from the 78th to the 81st parallel, and I have discovered the same relics of a numerous colony on the opposite coast near latitude 80°. I believe the northern shores of the lands of Grinnell and Washington will be found numerously peopled, and that the link within the channel has been broken, in consequence of the destruction of the hunting grounds by the gradual enlargement of the great Humboldt Glacier, and the enormous discharge of ice-bergs therefrom, producing a local increase of climatic severity. A similar glacial accumulation in Melville Bay, between latitudes 74° and 76°, has cut off communication between the inhabitants of the head waters of Baffin's Bay and of southern Greenland.

That the central home of the race is nearer the Pole than yet explored, would seem to be indicated by the fact that as we advanced southward the race deteriorates. The most northern known branch of the family is that with which Dr. Kane had constant communication, at the mouth of Smith's Strait, and these people exceed in physical development any others hitherto discovered. In south Greenland they are quite diminutive, so much so that the Northmen who discovered the continent in the tenth century, named them from their diminutive appearance "Skrællings." The same fact is observed in Labrador; and the old Norwegians who in their wild wanderings came early in the eleventh century several degrees lower on the coast, found the same people, with the same characteristics. My excellent comrade, the late Mr. McGeary, has assured me that the natives about Pond's Bay are far superior in physical development to the inhabitants of Labrador. In some of the southern settlements I have found the height five feet four inches (5 feet 4 inches) very

unusual; five feet one inch was thought by Crantz to be a fair average. The Smith's Strait Esquimaux reach frequently to five feet six inches; several measured by me gave five feet seven inches, and one, five feet eight and a half inches. These facts are valuable if we accept the theory that races deteriorate as removed from the parallel of their nativity, and if they inhabit the lands to the north of Smith's Strait, there is there continual open water, for they, like the birds, draw their subsistence entirely therefrom, and like them too, supply their wants from day to day, through summer and winter.

But the most important fact, which we have to consider, are of direct determination—I mean the observed water temperatures and their known influence. The facts in our possession, although few, and confined to an extremely limited number of observers, are nevertheless conclusive as to this one point, viz.: that the great body of the waters of the Polar Basin have a temperature considerably removed from the freezing point; and to the immense frigorific influence acting continually upon them, there is evidently a calorific force antagonistically operating. That the latter holds sway during the summer, and clears the greater part of the Basin from ice during that period, there can be no doubt. How far its influence is felt during the period of the year when the atmospheric temperature sinks below the freezing point of mercury, we have, as already stated, little positive information. There are some observations however upon this point which have interest and value.

Baron von Wrangel at his winter quarters at Nishne Kolymsk, records that the temperature rose in winter and fell in summer with the north winds, and that the "N.N.W., and sometimes the N.E. winds were damp to a degree which was sufficient to wet their clothes;" and according to Mr. Tooke, at Koolo "the cold diminishes during the severest weather with the northerly winds." Barrentz at Nova Zembla found a heavy swell coming from the northward, clearly indicating the close proximity of open water; and the same fact has been noted at the Seven Islands, though I should observe that this only relates to the summer.

Sir Edward Parry, upon whose observations we may always properly rely, found at Winter Harbor, Melville Island, that the north winds were often warm. The same fact was noted by Dr. Kane at Rensselaer Harbor, and although the north and northeast winds were frequently cold during the winter, yet the summer winds from that direction brought sometimes warm and foggy weather, and throughout the year a most curious phenomenon was witnessed upon the north horizon. A heavy mist bank floated there almost continually, and, "mist bank on the north horizon" became a stereotyped entry in our meterological tables.

I give these facts without comment or opinion, and will content myself with grouping them with other observed phenomena.

The water to the S.W. of us was open throughout the winter as well as summer. I saw, in December 1854, a large watery area off Cape Alexander, and as late as the 29th of the following month, Dr. Kane discovered a broad sheet, nearly free from ice, stretching out from Cape Hatherton, forty-five miles to the S.W of Rensselaer Bay. This water was frozen over during February, but we have the testimony of the Esquimaux that to the south of Cape Alexander, at a point opposite Ak-oot-loo-nik, latitude 77° 30′, there was an open sea as late as the middle of March, and in closing his journal entry of the fact, Dr. Kane "questions very much, if such extensive areas as the so-called north water ever close completely;" and this "north water," as the whalers call that portion of Baffin's Bay lying to the northward of the "middle ice," has a superficial area of less than eighty thousand (80,000) square miles. The Esquimaux inhabiting its shores are dependent upon its remaining open throughout the winter for their existence. A sudden or long continued closure would be the signal for their total destruction by starvation, for these improvident creatures have rarely reserved stores sufficient to last them during two weeks.

I will not hazard any opinion as to the mid-winter condition of the sea to the north of Rensselaer Harbor—in which direction the mist bank was seen; but we know, that one hundred miles in a due north line from it, there was an open sea in June, 1854, as shown by the well authenticated report of William Morton. The temperature of this sea as determined by Morton, and as recorded by his commander, was 36°; two degrees above the temperature of the air at the time of observation, and eight degrees above the freezing point of sea water. Another observation made in a different locality gave a temperature for the sea-water of 40°. This water came down from the north at the rate of from two to four knots. From the same quarter blew a strong gale of wind, and no ice was seen as far as the eye could reach at an elevation of from three to five hundred feet.

Where this warm water comes from is an important question, and one involving the whole system of Arctic currents, about which so little is positively known. That little, I have not the wish, even had I the ability, to use in any speculative hypothesis. There are members of this Association, who, by their devotion to science, have earned a claim to speak upon this topic, and in their able hands I leave it.

I cannot, however, wholly abandon the subject without citing a few observations, and calling attention to the striking tendency

which seems to exist towards a great system of revolving currents. In the Greenland sea near Spitzbergen, the deep sea water is, according to Scoresby, warmer than the surface. A series of observations made by this distinguished navigator and philosopher, between the tenth meridian of western and the tenth of eastern longitude, and between the parallels 76° 16′ and 80°, show a constantly increasing temperature from the surface downward. The mean of nine observations with a mean latitude 77° 40′, gave a surface temperature 29·1° with extremes 28·1° and 30°, and at a mean depth of 665 feet the mean temperature was four degrees higher. A single observation taken in latitude 79° at the depth of 2,400 feet gave a temperature of 36°, at 4,380 feet the temperature was 37°, and at 4,556 feet in latitude 78° the temperature was 38°. Dr. Scoresby thought this deep warm water to be "a still further continuation of the Gulf Stream." Be this as it may, the current about the new Siberian islands is westward, and we have doubtless a continuation of this flow in the great Polar drift of the Greenland sea; another current sets south through the estuaries leading into and from Baffin's and Hudson's Bays.

That there are northward currents to keep the waters of the Polar Basin in equilibrium must be evident. In Baffin's Bay it is well known that the deeper ice bergs are carried northward, while the surface ice is drifting south, thus showing a deep sea current setting toward the Pole. The Behring Strait current runs in the same direction. The Gulf Stream after sending off a bifurcation to the southeast, stretches northward to the Norway coast, and is lost to observation beyond North Cape. The great Arctic water-sheds of Europe, Asia, and America, equaling together nearly five millions (5,000,000) of square miles, pour down their immense floods of warm water into the Arctic seas.

Speculate as we will, the facts in our possession show conclusively what was assumed in the outset, viz.: the existence of a cause constantly operating to keep the waters of the north Polar Basin elevated above freezing, and fully believing that this cause, aided by the influences of the superficial local action of winds, tides, and currents, is sufficient to produce a constant open sea in the neighborhood of the Pole, (that is, assuming the immediate vicinity of the Pole to be water,) I have great confidence that it can be successfully navigated. The route most practicable for accomplishing this purpose I believe to be through the great Polar estuary, separating the lands of America and Greenland, assuming severally the names, Davis' Strait, Baffin's Bay, Smith's Strait, and Kennedy Channel.

The direct efforts hitherto made for the purpose of reaching the North Pole have been confined to the Greenland sea. The

first attempts were made at the time of the origin of the famous Muscovy company, when the commercial nations of Western Europe held rivalry for the quickest passage to the Indies. Their efforts have been continued at intervals until our own time, and have uniformly resulted in failure as to the principal object.

Hudson is said to have penetrated in 1607 to latitude 82°, but the conflict between his nautical observations and his descriptions of land, make it doubtful whether he passed beyond 81°. The brave but unfortunate Barentz, and his companion, Corneliz Ryp, eleven years earlier had been driven back from the eightieth parallel; and Fotherby, a few years later, after repeated efforts, had no better success. Poole, in 1610, reached only to 79° 50′. The greatest latitute of Captain Phipps, in 1773, was 80° 48′; of Tschitskagoff, in 1776, 80° 30′; of Scoresby, in 1806, 81° 30′; of Buchan and Franklin, in 1818, 80° 32′; of Clavering, in 1823, 80° 20′. They were all arrested by the solid ice barrier near the meridian of Spitzbergen.

The closest approach to the Pole of which we have any well authenticated record, was made by the late Sir Edward Parry, to whose daring attempt I have already referred. This fearless navigator, abandoning his vessel, boldly pushed out upon the boundlesss ice-covered ocean, but was forced to retreat after reaching to 82° 45.

It would be highly important to determine with positive accuracy the progress in this direction of the early Dutch and English fishermen. Barrington declared that the ice barrier was not continuous from Greenland to Nova Zembla, but was broken on a movable meridian above Spitzbergen, allowing a free passage into the centre of the Arctic Ocean, which he maintained was an open sea, and had been frequently navigated. In two papers read before the Royal Society, in 1775, he cites twenty-six instances of navigators having reached to high north latitudes, and asserted, that a vessel had gone, even to the very Pole. But the testimony upon which these extraordinary reports is founded is extremely loose and unreliable, and subsequent writers have attached very little importance to them. Scoresby and Dr. Kane wholly discarded, and Barrow only partially accepted them. If true, these seas have since undergone remarkable changes in their physical aspects; and after a careful examination of the records of the more recent navigators, I am convinced, that the route to the North Pole, eastward of Greenland, is at this time neither practicable nor safe, and I believe that there is very little probability that that Pole of the earth will be reached wholly by water from any quarter. To effect this desirable object reliance must be placed upon *boats*, for the navigation of the circumpolar waters, and upon sledges for the transit of the boats over the investing

ice belt. The routes of Parry and Kane are both before us. As already stated, the advantages are greatly in favor of the latter.

I have already shown that the chief cause of the failure of Captain Parry was the southward drifting of the ice plain upon which he travelled. This difficulty is obviated by adopting the route through the channel to the westward of Greenland, for we have here the land masses of Washington and Grinnell, and the protruding tongue of western Greenland, which terminates in Cape Alexander, to check the equatorial drift of the ice as it breaks up early in the season. This route possesses, besides, other advantages equally important. The lands on both sides of Kennedy Channel have a nearly due north trend, continuing at least to latitude 82° 30′, affording a certain basis of operations upon the direct line of descent. They have a marginal belt of ice, at certain seasons, always smooth and secure, and they furnish a practicable field for travel, a secure foundation for depot stations, more secure than the treacherous outside ice, and a safe retreat for travelling parties if surprised at a distance from the land by a sudden disruption of the "floes."

A small vessel might be forced into Smith's Strait, and along the western shore, by working through the land leads, could reach, I have reason to believe from personal observations made in the spring of 1854, nearly to latitude 80°. Here the coast affords fine harbors for wintering. Upon the opening of spring, depot stations, or *caches*, could be established with dog sledges at different points along the land, and early in April a boat mounted upon runners might be started towards the open sea, which, enlarging with the advance of the season, would, I conjecture, be met between the 81st and 82d parallels by the middle of May. The distance thence to the Pole is not very great, and the navigable season continues for four months. I can see no insurmountable obstacle to complete success.

Gentlemen of the Association: If I may, without presumption, address myself directly to you, I would earnestly call your attention to this subject. It is brought before us, not in the days of Baffin and Hudson, nor in those of Parry and Franklin. It comes to us rich in the experience gained by more than three centuries of almost continuous effort, demanding of us to achieve the climax of discovery, to complete the effort so long and so bravely persisted in.

I have for some time been endeavoring to organize another expedition to those seas. After more than two years spent upon the route which I have recommended, I am convinced that if the experience of the past be properly used, the next attempt will in all human probability be successful, and that it can be accomplished with far less expense and danger than is popularly

supposed. A vessel of one hundred tons, equipped for two and a half years, and manned by twelve men, is all that is absolutely necessary. To this might, with advantage, be added a small steam tender, not exceeding thirty tons, fitted with a shifting screw. Under certain circumstances this little craft could be made available in the shoal water, close under the land, in the narrow shore leads of Smith's Strait.

At first this might seem inadequate to the service, and compared with the large force with which the English have latterly gone into the field is indeed small; but experience has shown that success in Arctic enterprise has not always been in proportion to magnitude of preparation. The brilliant triumphs of Davis, Frobisher, Baffin, Hudson, and others of the early navigators, were made with vessels varying from fifteen to fifty tons. The expedition should leave the United States early in April, and halting upon the Greenland coast to the south of Melville Bay, should procure at the different trading and missionary posts of the Danish government, and by the hunt, a supply of fresh meats and furs, and two good teams of Esquimaux dogs. This supply would greatly reduce the cost of the expedition, and would be in every way better than to carry all the stores from home. Large quantities of the flesh of the reindeer, water-fowl, and seal, could be obtained. The whalers annually capture great numbers of the Auk and Lumme (*Uria Alle* and *U. Brunnichii*) about Sanderson's Hope and Cape Shackleton, and at the Duck Islands they collect the eggs of the Eider fowl almost in boat loads. About Holsteinsborg and Egedesminde the reindeer (*Cervus Tarandus*) are quite numerous, their skins forming one of the staple articles of revenue from the colonies. Considerable quantities of their dried flesh (cured without salt) could be obtained of the natives and Danish officials. It was the original intention of Dr. Kane to have availed himself largely of these abundant stores, but he arrived too late upon the coast to admit of a halt without great risk of losing the chances of reaching his proposed ground of search before the close of the season. This delay was occasioned, as you are aware, by the unfortunate sickness which, during nearly a month, prevented his departure from New York.

The "Middle Ice" commences to break up about the first of June or late in May, and the passage into Smith's Strait could be effected by the first of August. Running up the coast of Grinnell Land, I should select a safe harbor at some eligible point as far north as the ice would admit, and there pass the winter. I have already expressed my belief in the practicability of reaching nearly to the 80th parallel, or at least I feel well assured, that the little Bight between Capes Frazer and Leidy, latitude 79° 42′,

can be attained. An examination of this Bay, with the ultimate view of one day being able to winter in it, was made by me in the spring of 1854. Before passing from this point I will call attention to some features of the physical geography of this channel, which have an important bearing upon the proposed operations, and which should govern the selection of a harbor. By a reference to the chart it will be seen that Smith's Strait runs diagonally to the general direction of the current coming down through Kennedy Channel, and in consequence, the Greenland shore will have the ice continually forced upon it by the pressure of the moving water; the same cause meanwhile freeing the opposite coast. That this side will afford greater facilities for reaching a high north latitude will be evident, and travelling parties would be protected against the chief difficulties which beset Dr. Kane in crossing the ridges of hummocked ice in the centre of the Strait.

It is on this western coast that the small steamer to which I have referred might be made serviceable, and in this opinion I am supported by the judgment of my friend, Mr. Wilson, late the sailing master of the "Advance." During a mild season the dissolution of the land margin of the ice fields is considerable, and a vessel of shallow draught propelled by steam, might possibly be able to work through Kennedy Channel into the Polar Sea. But this would be too doubtful a reliance for sole dependence. The main hope of success should be in the *boats*. Early in the spring, the shores of Grinnell Land should be—as already stated—lined with depots of provisions, as far north as latitude 82°, where a final *cache* should be established for the use of the polar boat party; these stores to be carried forward by the dogs. One of these animals will drag upon a sledge a weight of seventy (70) pounds thirty-two (32) miles per day, upon an average ration of thirteen (13) ounces of pemican—equal to about three pounds of dried meat—and two teams of seven each could readily carry forward ample stores for a full boat's crew of six persons. This crew should start their boat from the vessel in April. Within one hundred and fifty miles they would probably, as I have said, meet the open water by the middle of May or the first of June.

The chief difficulties which have hitherto beset Arctic travellers can be mainly overcome. The rough ice which baffled Dr. Kane's parties, as above observed, can be in a great measure avoided by avoiding the crossing of Smith's Strait; and Kennedy Channel having a due north trend, and presenting no salient capes like the remarkable projection of western Greenland, will, I have no doubt, be found mostly smooth. Such a track presents great facilities for travel. One man will readily walk sixteen (16) miles per day, dragging from one hundred (100) to one hundred

and twenty (120) pounds in weight. Dr. Rae conducted a party six hundred miles in twenty-two days, each of his men trailing after him, upon an Iroquois sledge, one hundred and ten (110) pounds. They carried a single blanket and change of clothing per man, but no tent, using for periodic rest the snow hut of the Esquimaux. These huts are readily constructed, and upon them I should place my sole reliance while upon the ice. Indeed, the amount of labor which can be performed by a skillful use of very simple means is truly astonishing; and in spite of the cold and poverty of the ice deserts, Kennedy, McClintock, Bellot, Sutherland, Pim, Osborne, Richards, and many others of the numerous corps of their gallant co-laborers have performed journeys which for extent would reflect honorably upon them as foot travellers in a more favored region.

The cold and scurvy are of much less serious moment than formerly. Experience has taught us many valuable lessons. By housing in the upper deck of the vessel, and using the porous snow as an external covering, the winters may be passed in health and comparative comfort, and even travelling may be performed during this season, if the parties are well supplied with heavy furs and sufficient quantities of carbonaceous food. The scurvy, hitherto often a great scourge to the crews of vessels wintering in the Arctic regions, can, with proper precaution, be resisted, and in this opinion I am sustained by the united testimony of the surgeons of Her Majesty's Arctic Squadron. The disease has been of very rare occurrence of late years, and wherever it has appeared, it has been owing to accidental causes, but chiefly from the long continued use of a salt meat diet—either in consequence of the parties never having been provided with any other standard supplies of food, or of their having so long remained in the field as to have consumed their fresh stores. Indeed, I am convinced that the climate is one of unusual heathfulness. The suffering from the disease among Dr. Kane's crew was mainly owing to the above mentioned cause. He started too early to profit fully by the discoveries which have been made in the art of preserving fresh meats and vegetables, and with the exception of a limited quantity of pemican—intended for use in the field—he had to depend upon the ordinary navy ration, without change or variation. Casual supplies of fresh food were obtained by the hunt or in barter with the natives, and when procured, invariably enabled his men to resist the disease, or, if developed, it acted as an immediate and specific cure. The difficulty experienced in keeping alive his dogs was chiefly owing to the absence of a diet suited to their necessities. The salt of the meat acted injuriously upon them, and the insufficient quantities which they could eat, did not enable them successfully to resist

the cold, and a strange epilepto-tetanoidal disease was in consequence developed among them. The same was observable among his crew, and doubtless for the same reason.

I have thus as briefly as possible given the reasons for believing in the existence of an open Polar Sea, and that through it the North Pole may be reached. Experience has reduced the scheme to a mere question of time. If not accomplished at this, it will be at no very distant day.

I have already announced to you my intention of laboring for the accomplishment of this object, and to this end I would respectfully solicit the counsel and sympathy of the Association. In this presence it would be useless to enumerate the results to science to be anticipated from its success. Some of them may, however, with propriety be briefly alluded to.

Under all circumstances, valuable additions would be made to our knowledge of Arctic climatology, and I should hope to determine something definite with regard to the condition, during the winter, of the waters beyond latitude 82°, and thus definitely settle the question, as to the *permanent* existence of the open Polar Sea, by passing a part of that season as far north upon the shores of Grinnell Land as possible. After entering winter harbor, and upon the earliest freezing, I should establish a depot of provisions in that direction, and with one companion and a team of dogs, would there pass the months of December, January, and February, in a *snow-house*. The land ice could be travelled during the moonlight period of each month, and observations made upon the situation and temperature of open water. Such a plan of operations is, under ordinary circumstances, quite practicable. That the months of September and October are available for the purpose of establishing provision depots, has been proven by my bold, daring, hardy co-laborer in the late expedition, Mr. Bonsall. That the winter may be passed in the manner above described, is shown by the experience of the enterprising and indefatigable chief factor, Rae, who, as you are aware, passed the winter, preceding his famous journey upon which he found the relics of Franklin's party, in *snow-huts* at Repulse Bay, and as he assures me, without any serious inconvenience from the cold, and without disease. To the experience of Dr. Rae I will add my own. During the autumn of 1854, while on duty connected with the safe retreat of the late expedition to the south, from Rensselaer Harbor, I passed in a similar manner with seven others of the ship's company the months of October, November, and part of December, and performed a return journey of three hundred miles, in eight days, with the dog sledges of the Esquimaux, guided only by the light of the moon and the stars. We lived during this period entirely without fire, for purposes of warmth, and but

for a want of food, could have passed the winter in safety. The temperature of the hut sank rarely to zero, and was often as high as the freezing point, being kept thus elevated by the heat radiated from the persons of the occupants.

I have already shown the importance of these northern lands as offering positions for observations upon the *human* and *floral* life of the region; and lying almost in a direct line between the two great magnetic centres, the great value of stations in the high latitudes of Grinnell Land for magnetic determination can hardly be overestimated. Our knowledge of the oceanic currents and tides of the extensive waters of the Polar Basin is enveloped in the same mystery which invests the regions of their birth and flow, and as the proposed line of descent runs midway between the seat of Atlantic and Pacific influences, it presents a most important field for the completion of the hydrographic survey of the northern hemisphere. Indeed, there is no department of physical science or natural history to which the expedition could not be made to contribute.

The collections of natural history made during the cruise of the "Advance," which were unfortunately abandoned with the vessel, exhibited a hitherto unknown feature in Greenland zoology—containing as they did, a number of skulls of the musk ox (*Ovibos moschatus*) found in almost every locality visited between latitudes 78° and 79°, by Dr. Kane, Mr. Goodfellow and other members of the party on the coast, and discovered by Mr. Wilson and myself near the base of the Great Glacier, about eighty miles eastward from Rensselaer Harbor, on the parallel 78° 40′. These animals seem to have become extinct on the continent of Greenland to the south of latitude 80°, but I have been assured by the Esquimaux that they still exist to the far north, and they speak of a large island in that direction upon which they live in great numbers.

The northern range of the *Cetaccea* is not known, and it would be highly important to determine whether they inhabit the extreme northern limit of our planet. I conjecture that their central *habitat* is about the Pole. Whales struck in the Greenland Sea near Spitzbergen have been caught to the southward of Behring Strait—recognized as the same animals by the harpoons remaining imbedded in their flesh—thus proving conclusively, that both from the Atlantic and Pacific oceans, they have free communication with the regions of extreme northness. These animals cannot live in an ice-covered sea. The once valuable fishing grounds of the Greenland Sea and Baffin's Bay are now almost unproductive, and the Right whale (*Balena Mysticetus*) is fast disappearing from the "northwest coast." It would be interesting to

determine whether they have been destroyed or driven within their ice-locked fortress. This last I think highly probable; and it would seem to be shown by a fact, stated by Dr. Kane in a paper read before the American Geographical and Statistical Society in December, 1852, upon "Access to An Open Polar Sea:" viz. that he observed the White Whale (*Delphinapterus Beluga*) passing up Wellington Channel, northward, through a broken sea of ice for four days in October. The Barbed Seal (*Phoca barbata*), was seen by Morton sporting in the waters of Kennedy Channel. These animals must have been denizens of the north, for since this species is not endowed with mechanical powers for opening breathing places in the ice, they could not have reached this water from the south, for this would have required them to pass underneath an unbroken belt of ice more than one hundred miles in width, which, I need hardly say, would be impossible. In its proper place I might have cited this fact, as well as the capturing by Morton and Hans of two Polar Bears (*Ursus maritimus*) near the same spot, as bearing strongly upon the existence of continual open water.

The lower forms of marine life have not been studied, and present a broad field for the investigations of the naturalist. Important problems are involved in the determination of their geographical distribution.

The Great Glacial system of Greenland has been subject to but little enlightened investigation. Giesecke thought this vast ice continent, as I shall venture to call it—which is the birthplace of the untold millions of tons of annual berg-discharge which come down from the north into the Atlantic—was a great congeries of islands, cemented together by ice. This continent, as it now appears, has a superficial area exceeding half a million of square miles, and it is the seat of constant atmospheric precipitation. The excess of this precipitation over evaporation—for evaporation, I may mention, takes place continually—and discharge by the river and icebergs, have an important bearing upon the physical geography and climatology of the region, and, indeed, of the whole northern hemisphere. Many of the geological phenomena of the ancient glacial period can at this time be witnessed almost everywhere on the Greenland coast.

The river system of Greenland—fed by the *Mer de Glace*—is greater than is generally supposed; large streams were discovered by Dr. Kane above latitude 78°. The great glacier of Humboldt, which bounds Smith's Strait to the northeast by a wall of ice sixty miles in length, and from fifty to five hundred feet in perpendicular altitude, is but a great frozen river—if I may so use the term—slowly flowing seaward, and discharging, piece by piece, its congealed fresh water into the salt sea, and

rafting millions of tons of detritus—boulders and sand—to more southern latitudes.

Upon all these points the portfolios of Dr. Kane will be found rich in material; and, when presented to the world it will, I am sure, give no cause to the distinguished Superintendent of the Coast Survey to regret the words of just and generous praise, which I had the gratification the other day, to hear bestowed by him upon this highly gifted man, for whose untimely death the world now mourns. But his facilities and opportunities were limited, and much remains to be accomplished.

I need not pursue the subject further, and have already detained the Association longer, perhaps, than the occasion warrants. The deep interest which I feel in a field of investigation, which has long engaged my attention, must serve as my apology.

ART. XXXVI.—*Review of Marcou's "Geology of North America."**

THE volume on American Geology just published by Mr. Jules Marcou, demands more than a passing notice. Coming from a Professor in the Federal Polytechnic School of Switzerland, who is known to have traversed this country widely, and whose memoirs and American geological map form part of the publications of the Geological Society of France besides being distributed through several European journals, it is of interest to all to inquire into the character of the work and the reliability of the author's conclusions.

It will be remembered that former writings of the author on the same topic have been noticed in this Journal; and as he takes exceptions to the statements which have been made, it is the more incumbent on us to reconsider the subject with his later volume before us. We wish only to seek out the truth, that we may honor it, and here register it for the use of the science.

The work on the Geology of North America contains, (1) an account of the author's researches in America; (2) a general re-

* Geology of North America, with Two Reports on the Praries of Arkansas and Texas, the Rocky Mountains of New Mexico, and the Sierra Nevada of California, originally made for the United States Government by JULES MARCOU, Professor of Geology in the Federal Polytechnic School of Switzerland, formerly United States Geologist, etc. 144 pp., 4to., with three maps and seven plates. Zurich, 1858.

With regard to the title of "United States Geologist," we remark for the enlightenment of foreign readers, that there is no such office under the Government, and no national Geological Corps. When an expedition for exploration and survey is organizing, some person is usually associated with the party for scientific research, by appointment from the Department in charge of the survey. Those selected are sometimes good geologists and sometimes otherwise.

view of the geology of the continent with reference to the geological map; (3) a classification of the mountains of part of North America; (4) a review of his reviewers; (5) a history of the progress of American geology. The question important to geologists—to European more than American—is, whether American geology is correctly represented.

I. History of Geology.—Mr. Marcou commences by republishing the observations of Maclure on the Geology of the United States with the accompanying map, from Vol. VI. of the Transactions of the American Philosophical Society, doing full justice to this earliest of American explorers. He reviews the labors of many who have followed him, making honorable mention, as he should, of Vanuxem, one of the ablest of our geologists, of Hitchcock, Owen, and others. But we are sorry to see imperfections in the history, which evince that personal disappointments have warped the author's judgment. Professor Hall's connection with American palæontology is well known to the world. Mr. Marcou, enumerating in a paragraph the cultivators of palæontology in America, mentions "Lesueur, Harlan, Jefferson, Say, Green, Bigsby, Rafinesque, Troost, Morton, Redfield, Lea, and Hitchcock;" then, Conrad and Leidy, as taking the lead of all, the "best palæontologists in the United States," and ends with what he calls "the young palæontologists of the present day," "Dr. Shumard, Holmes, Newberry, Meek, Wyman, Billings, etc."; Hall's name is not included. He has honored him, however, with a separate paragraph, in which he speaks of the "Palæontology of the State of New York by James Hall," as "a very useful work;" and then closes a disparaging sentence with, "the best part of it being the plates drawn by Mrs. Hall, and also the geological order." Conrad and Leidy are highly appreciated. But in his treatment of others, the author shows that he has himself been reviewed. This is apparent also in the closing sentence of this brief History of American Geology. "Maclure, Vanuxem, Hitchcock, Taylor, Conrad, Emmons, Lyell, de Verneuil, and David Dale Owen, are the *only discoverers;* other geologists have extended and detailed the just views and grand ideas that these illustrious savants were the first to divulge:"—an association of names that will surprise, by its omissions if not otherwise, those who know much of science in America and little of the influences that have operated upon the author of this history. Mr. Marcou shows again that he has had reviewers, in the remark that he makes about "the half dozen hieroglyphical pamphlets" published as the Geological Report of Progress of the Canada Survey. He evinces that his American conclusions have met with opposition, also, by his slight of Foster and Whitney's in-

vestigations in northern Michigan, and of the various researches of the Professors Rogers, and by his studied neglect of others.*

There are also imperfections in the History arising from a partial acquaintance with the subject and the science. Thus he speaks of Mr. E. James as having been the first to recognize the "New Red Sandstone" on the slopes of the Rocky Mountains, when all he had any knowledge of was *a red sandstone*. He speaks of the knowledge of the geographical extension of the "New Red" being due to Dr. D. Houghton and others for Lake Superior, when no evidence of its existence in the Lake Superior region is yet known or was ever detected. He speaks of the discovery of the "Old Red" by Taylor, when the so-called "Old Red" is only the upper part of the American Devonian.

Without further specifications, it is plain that in this history the author has neither dealt fairly with others or the subject.

II. Review of the Reviewers.—We refer to this chapter merely to add, that the personal feeling above attributed to the author, is here acknowledged. We are very sure, that only the belief that Mr. Marcou was propagating in his publications erroneous views abroad, led to the notices of his memoirs and former map that have so chafed him. On no other ground than a desire to promote the interests of science have the pages of this Journal been open to the criticisms.

III. Mountain Systems.—The author describes the mountain systems of North America and their ages, as he supposes they must be according to the theoretical views of Elie de Beaumont. A determination of the age and relations of each by means of observed facts would be positive knowledge and of some service to the science.

IV. Researches.—The points in the explorations of the author which give his work special prominence, are the assumed identification—

(1.) of Triassic rocks in the Lake Superior region;

(2.) of the Permian Formation over the slopes of the Rocky Mountains;

(3.) of Triassic rocks in the same Rocky Mountain regions;

(4.) of Jurassic rocks, in the same region.

We should take pleasure in claiming for the author the establishment of either one or all these points, if we could justly

* Mr. Marcou says, with characteristic self-complacency, and with evident irritation because others do not call "New Red," what he does: "The brothers Rogers and James Hall try their best to suppress the New Red Sandstone formation in America," &c.; and after making various absurd statements and suggestions, bringing in Logan for a share of his attempted ridicule, he adds respecting them, "I would advise these honorable savants to consider if one of these determinations would not be preferable."

do it. The progress of American geology is largely due to foreign geologists—to Lyell of England, and De Verneuil of France; and they are honored for their labors. They were wise men; appreciating geological evidence, they used it cautiously and surely, and made each step a step of real progress. They did not conclude, when they came across *a* red sandstone, that it was *the* "New Red" or *the* "Old Red;" or on the discovery of a *magnesian* limestone, that it was *the* magnesian limestone of the Permian. They knew, with all other geologists, that mere color and mineral characters were the very worst test of equivalency between the rocks of the two continents; that the test will not answer even for the United States alone; that an appeal to such characters in this period of geological science betrays great want of experience. They came to the country expressly to subject all such considerations to the higher test of organic remains, and in this their great merit consists. Mr. Marcou, we regret to see, has taken the course which they rejected and which science long since repudiated. It is true the region he examined was nearly destitute of fossils. But there was so much the more reason for doubting, as all others had done before him.

1. *Triassic Rocks in the Lake Superior Region.*

The only evidence that these rocks are Triassic, given by the author, is of the superficial kind just referred to. He has not claimed to find a fossil in the beds or any proof that decides the question. He remarks that Dr. Jackson "confirmed the justice" of the view by finding beds with *Pentamerus oblongus*, an Upper Silurian fossil, on Keweenaw Bay. But it is known that the strata of Keweenaw Point overlie the red sandstone; and Hall has shown them to be Lower Silurian from the fossils collected there by Foster and Whitney. (See F. and W.'s Report, Part I, p. 118.) Even if the red sandstone were above the Silurian, this would not make it Triassic, according to any known rule of geological reasoning.

The similarity of the beds and the associated trap to the Connecticut River rocks, led early to the *supposition* that both might be of the same age, but it was no basis for such knowledge as Mr. Marcou claims. Foster, Whitney, Hall, Logan, and others, have been over the same ground, and argue from the fossils and superposition that the rocks are as old as the Potsdam Sandstone. And yet Mr. Marcou still maintains, against all the investigations more recent than his own, and on evidence which geologists know to be worthless, that the rocks are *Triassic*. Mr. Marcou states that these geologists hold the *old* opinion, when on the contrary his view is the old one, and the only one current until the evidence became known which these geologists themselves brought forward.

2. *Permian Rocks in the Rocky Mountains.*

In the "Itinéraire Géologique du Fort Smith et Napoléon, (Arkansas) au Rio Colorado de Californie," in 1853,* Mr. Marcou states, in his notes for Dec. 22, after describing what he calls the *New Red Sandstone* of the region, "Puis on a au-dessous un calcaire magnésien ou dolomitique épais à stratification régulière de ½ à un pied d'épaisseur, plongeant au nord sous un angle de 10 à 15°, en stratification concordante avec le *New Red*, et quelques assises du *magnesian limestone* alternant avec le grés rouge à la base. Dans ce *magnesian* on a une couche avec fossiles trés mal conservés; je crois reconnaître des fragments de *Belemnite?* un *Nautilus?* un *Pteroceras?* Quatre milles après avoir marché sur ce *magnesian* on a la lave du volcan qui la recouvre; et nous campons sur la base, non loin des cones secondaires du grand volcan. Pas de diluvium. And the "Résumé" by himself, published in the same volume, says respecting these observations: "Shortly after quitting the Colorado Chiquito we found here, with the last beds of the red clay of the Trias and in concordant stratification, a magnesian or dolomitic limestone, with very regular strata from half a foot to one foot in thickness. Several beds contain fossils badly preserved; among which I recognised, however, a *Nautilus*, a *Pteroceras*, and a *Belemnites*. This formation, which is placed between the Carboniferous and the Trias, corresponds, without doubt, to the magnesian limestone of England, and is a new member which I add to the series of secondary rocks in North America. "This magnesian limestone has only four miles of extent in the place where we crossed it, and disappears beneath lava and volcanic ashes. I have observed it farther to the west, and it appears also to occupy eastward one of the lesser chains of the Sierra de Mogoyon."

In the new work, this paragraph remains the same, except that in the place of "a Pteroceras, a Belemnites," it reads "a Gasteropoda, and perhaps a Belemnites;" and after the words magnesian limestone, in the line before the last, "(*Permian*)" is inserted.

When the discovery of Permian fossils west of the Mississippi was announced, a few months since, before the Geological Society of France, Mr. d'Archiac put forward Marcou's claim to the first discovery of the Permian in the Rocky Mountains, basing it upon this very observation, stating that this *magnesian limestone* was compared by him with the magnesian limestone of England, but that the fossils were too imperfect for determination.†

Here then, although the Permian magnesian limestone of one part of England is not represented by a similar limestone in all

* Published in the Pacific Railroad Reports, vol. iii.

† See this Journal, this volume, p. 260.

other Permian regions of Britain, nor in a great part of the Permian region on the Rhine and in Russia; although Murchison says, "In the exploration of Russia, geologists were taught by the diversified Permian group not to dwell on the local mineral distinctions of central or western Europe, but to look to the wide spread of certain fossil remains, which, in vastly distant countries, occupy the same horizon;" although in North America, magnesian limestones are known of all ages, of the Potsdam, Trenton, Upper Silurian, Devonian, and Carboniferous eras; and although it is very common in all formations that limestones are equivalents, even on the same continent, of sandstones and shales; yet we have the decision that *a magnesian* limestone in the Rocky Mountains, lying beneath what is regarded as the "New Red Sandstone," is the equivalent of *the* magnesian limestone of England. This certainly cannot be regarded as a safe deduction from geological evidence. The fossils were too imperfect to be identified. Yet among them, "a *Nautilus*, a *Pteroceras* and a *Belemnite*" were recognized; or as stated in his new work "a *Nautilus*, a *Gasteropoda*, [he meant to say *Gasteropod*, the singular number], and perhaps a Belemnite." Now "a Nautilus" proves nothing as to its being *the* magnesian limestone; "a Pteroceras" is direct testimony against it; and "a Belemnite"? according to all authors, affords the idea no more encouragement. "A Nautilus, a Gasteropod, and a Belemnite?" prove this magnesian limestone to be Cretaceous, or Jurassic, and not older than Jurassic, if the evidence may be used at all. The cautious geologist would have certainly doubted his "New Red" or Triassic, if he found it overlying beds containing what was probably a Belemnite. The evidence, if worth anything, abolishes both the Triassic and Permian together.*

We conclude, therefore, that credit cannot be claimed by or for the author, with regard to the discovery of the Permian in the Rocky Mountains.

3. *Triassic Formation in the Rocky Mountains.*

Mr. Marcou observes that "this formation, which I was the first to notice and recognize in the West, (see *A Geological Map of the United States and the British Provinces of North America;*

* This attempt at the identification of Permian beds in the Rocky Mountains, is in strong contrast with the method of research of Professor Emmons in North Carolina. Prof. Emmons's discovery in that State of Thecodont Saurians, the same group of Reptiles that characterizes the Permian in Europe, constitutes a strong argument in behalf of the existence there of this formation. And if a full survey of all the fossils, both of plants and animals, and a comparison with those of Europe, lead to a modification of the view, it is no discredit to him. He has the honor of aiding in bringing about the comparison and helping on towards the final result. Mr. Marcou's dashing style of work is equally in contrast with the mode of investigation which has at last resulted in detecting Permian strata west of the Mississippi

Boston, 1853, p. 42,) attains a very considerable development, and according to my observations has a thickness of four or five thousand feet." Three divisions are made out by him, (1) the lower, the equivalent of the *Bunter Sandstein;* (2) the middle, of the *Muschelkalk;* (3) the upper, of the *Variegated Marls* or *Keuper.* Here, then, we have not only the Trias identified, but even its European subdivisions—though with an acknowledgment that the divisions are not "very certain." We think it was a risky conjecture, for he found no fossils whatever to sustain the division into *Keuper, Muschelkalk* and *Bunter Sandstein.* This off-hand settling of a problem that requires great care even among the fossiliferous beds of Europe, was a bold exploit in geological gymnastics.

But as to the great Triassic formation itself, the only palæontological evidence is from a specimen of fossil wood, met with in latitude 35° 42′ 32″ N., and longitude 99° 36′ 10″ W., "a full grown tree with branches, very much resembling the *Pinites Fleurotii* of Dr. Mougeot which is found in the New Red Sandstone of the Val d'Ajol in the Vosges;" after which he adds, "and this establishes a connection between the *New Red* of France and that of America." Thus one single fossil—that one, a species of Pine, and only "very much resembling the *Pinites Fleurotii* of Dr. Mougeot," *establishes.* This is a very strong word for a geologist to use on evidence so small and so uncertain, with the fate of four or five thousand feet of rock at stake, and with the beds next beneath containing "perhaps Belemnites." The prudent observer would have said, "establishes nothing;" and such is the fact. The gypsum, the marls, red color, and other such characteristics are also mentioned to sustain the parallelism. But it is now well known that gypsum, marls, and red color occur both in the Cretaceous and Permian of the west, well illustrating the remark, that such proofs are worse than useless: they have always been a fertile source of error; they might have warranted a bare suggestion but not more, and as far as suggestion goes, that of James had long the precedence.

On *such* evidence, a region over the Rocky Mountains which is one thousand miles from north to south and eight hundred miles from east to west, is for the most part colored on the map as Triassic, or "Terrain du Nouveau Gres Rouge." Such a region—1000 miles by 800—would take in quite a respectable part of the continent of Europe.

The Triassic will probably be identified over the Rocky Mountain Region. But this going ahead of discovery shows more eagerness than good judgment or science.

4. *Jurassic Rocks in the Rocky Mountains.*

The strata referred by the author to the Jurassic age were observed by him over the Llano Estacado and other regions in the

vicinity. The identification in the case of these beds rests upon organic remains, as it ought; yet there is the same faith in mineral coincidences that has before been pointed out. The species mentioned are the *Gryphea dilatata* var. *Tucumcarii*, an Ostrea very near *Ostrea Marshii*, a *Trigonia* and a species of *Astarte;* but the identification rests mainly upon the *Ostrea* and *Gryphea*, which are figured on plate 4. Great importance, therefore, attaches to the right determination of these species; for if not Jurassic, if associated in other strata in the west with well known Cretaceous species, they serve as credentials for the Cretaceous instead of the Jurassic.

The bearing of the evidence from these fossils has been discussed in this Journal by Wm. P. Blake,* who has pronounced them Cretaceous; and this conclusion was previously arrived at by Professor Hall. But these persons are among the reviewers whom the author discredits, and we have consulted another able palæontologist, highly commended by Mr. Marcou. The following are the views on the subject, which he has furnished us:

"The species which Mr. Marcou refers to *Gryphea dilatata* Sowerby, is the true typical form of the Cretaceous species, *Gryphea Pitcheri* of Morton, as is shown by Conrad in the Mexican Boundary Report, vol. i, p. 155, pl. vii, fig. 3 and pl. x, fig. 2; see also Professor Hall, in the Pacific Railroad Reports, vol. iii, plate 2, figs. 1 to 6; and Dr. B. F. Shumard in Marcy's Report on the Exploration of the Red River, plate 6, p. 205. As it is known to range through a considerable thickness of rocks in the Southwest, containing numerous well-known Cretaceous fossils, (on which Dr. G. Shumard in the Transactions of the St. Louis Academy of Sciences, vol. i, p. 289, may also be consulted), we may safely conclude that it is distinct from Sowerby's Jurassic species. A glance at Morton's figure (Synopsis Organic Remains, plate 15, fig. 9), drawn from the original specimen from Arkansas, will satisfy any one of its identity in species with Mr. Marcou's figure, (plate 4, fig. 2).

"The Oyster figured on the same plate as the *O. Marshii* Sowerby, is the shell described by Dr. B. F. Shumard in Captain Marcy's Red River Report, (page 205, and fig. 2, plate 5,) under the name of *Ostrea subovata.* It occurs in the Cretaceous at Fort Washita, along with *Ammonites vespertinus* Morton, *Gryphea Pitcheri* Morton, (G. dilatata of Marcou), and species of *Exogyra, Pecten, Astarte*, etc. Both of these species, the *Ostrea* and *Gryphea*, were found extensively through the Cretaceous formation west of the Mississippi by Dr. G. Shumard."

According, therefore, to the best recent authorities, the fossils supposed to be Jurassic are really Cretaceous, and no evidence of Jurassic rocks in the great west is published as such by Mr.

* This Journal, [2], xxii, 383, 1856.

Marcou. This is bad luck for the Jurassic, Triassic and Permian of the Rocky Mountains, on which his claims to a place among the "discoverers" rests. His results, reduced to the simple facts ascertained, amount only to this—that the geology of the Rocky Mountain Region includes Cretaceous and Carboniferous rocks—a fact that was quite well known before.

Whoever then may identify true Permian, true Triassic, or true Jurassic strata, beyond the Mississippi, will not have borrowed from Mr. Marcou, and can owe him no credit.

But the subject is not one of mere credit to any person; for it is unfortunate in its bearing on the progress of geological science to have false views about some 500,000 square miles of territory, and much more besides, spread widely abroad through reputable Journals, and Transactions of distinguished European Societies.

We might here leave the author's researches. A few other topics, however, may have a brief word. And while criticising his labors, we would say that his work contains many observations that are better than his inferences.

We cite, at first, from our excellent palæontologist again respecting some Cretaceous and Carboniferous fossils. "The large *Gryphea* or *Exogyra* (plate 3, fig. 1) referred to *G. sinuata* of Sowerby, I am strongly inclined to believe is *E. ponderosa* of Rœmer, (Kreide von Texas, plate 9, fig. 2), which is only a variety of *E. costata* Say, as has been shown by Conrad in the Mexican Boundary Report, page 154, plate 9, fig. 1. The figure given by Rœmer represents a small individual, but he mentions that it grows to a great size. The only difference between *E. ponderosa* and *E. costata*, is that the latter is generally marked by distinct radiating costæ, while the former has none, or is but very obscurely marked in this way. There is, however, every intermediate gradation in this respect, between the two varieties. Both varieties occur in New Jersey, Alabama, and Tennessee, as well as in the Southwest. Sometimes the var. *ponderosa* attains a very large size, and it is not unfrequently from two to three inches in thickness."

"The *Gryphea Pitcheri* of Marcou (plate 5) has well marked differences from his *Gryphea dilatata* (the true *G. Pitcheri* of Morton). In referring the shell to *G. Pitcheri*, he follows Rœmer, who also fell into the same error, (Kreide von Texas, p. 75, plate 9, fig. 1). These differences are seen in the figures. Compare figure 5, plate 4, with that of his *G. dilatata* and Morton's figure of the true *G. Pitcheri:* the beak of the latter is truncated while that of the former is angular and laterally curved. This peculiar form has been noticed by Conrad (Boundary Survey Report, vol. i, plate 9, fig. 2 *a b*) as a variety of *G. Pitcheri* and designated *G. Pitcheri* var. *navia* (see also Hall, Pacific Railroad Re-

ports, vol. iii, p. 100). I feel convinced that it is distinct from the true *G. Pitcheri* of Morton, (Marcou's *G. dilatata*)."

"The shell figured on plate 7, fig. 3, as *Spirifer striatus*, is the *S. cameratus* of Morton, (Amer. Jour. Sci., xxix, 1836, p. 150, plate 2, fig. 3,) as has been determined by Prof. Hall. Rœmer described it under the name of *S. Meusebachanus* (Kreide von Texas, p. 88, plate xi, fig. 7), and in Stansbury's Report (Expedition to the Great Salt Lake) it is named *Sp. triplicatus* by Hall. Owen referred it to *Sp. fasciger* Eichwald. It is very common in the west, ranging from Ohio to the Rocky Mountains, and from Nebraska to New Mexico; Mr. Hayden found it in the Black Hills. It is known to range up nearly to the base of the Permian in Kansas; but I have no knowledge of its having ever been found in *Lower* Carboniferous rocks. Figure 2 on the same plate also referred to *S. striatus*, I am inclined to believe is not that species; some four or five American species appear to have been confounded by different authors under that name. There are many other American Carboniferous species set down as identical by Mr. Marcou and others, but it is well known to American palæontologists that the whole subject requires careful revision."

"Mr. Marcou, on page 67, in a note, mentions that fossils from Vancouver's Island, have been determined as Cretaceous by F. B. Meek; but he thinks the determination an error, and that they are Jurassic. In the paper referred to (Trans. Albany Institute, vol. iv, p. 37), Mr. Meek speaks of the fossils placed in his hands by Dr. Newberry as belonging apparently to two rocks. Part of them he pronounced decidedly as Cretaceous—among them a *Baculite*, which is not distinguishable from *B. ovatus*. As regards the rest, which were the larger part, he gave no decided opinion. Subsequently, (but before the publication of Mr. Marcou's work,) he mentioned to Dr. Newberry that the latter were probably Jurassic, and so it is stated by Dr. Newberry in the Pacific Railroad Report, vol. vi, p. 66."

On page 64, Mr. Marcou speaks of the *Coal Measures* at Umpqua in Southern Oregon, where they are not known. He has overlooked the Eocene Tertiary of California. He makes the strata in California, from which Dr. Trask describes Baculites and Ammonites, Jurassic, when they are obviously Cretaceous. But it is not necessary to enter into further details.

V. Geological Map.—This map is open to most of the objections noticed in the former reviews in this Journal,* and we need not repeat. With regard to the region beyond the Mississippi, we refer again to the palæontologist whose opinions we have cited, as he is well acquainted with that part of the continent. He

* Volume xvii, p. 199, 1854, and xxii, p. 383.

observes respecting the great yellow (Triassic) area on the map, of more than 500,000 square miles: "We now know beyond any reasonable doubt that all the country from the Platte to the British Possessions, and from the Missouri to the Black Hills is occupied by Cretaceous and Tertiary rocks. And as regards the region from the Platte southward to the Red River, very far the larger part is known to be *not* Triassic, while it is possible that the Trias may occur in some parts of it."

"The surface formations of the Llano Estacado, instead of being Jurassic, are Cretaceous; this is plain from the section of Pyramid Mountain, and also from numerous other facts collected by recent explorers. If the Jurassic rocks exist there, which I am inclined to believe is the case, they are, as at the Black Hills, an *underlying* and not an overlying rock." Again, "over the region, north of the Llano Estacado which on the map is colored as Jurassic, the Cretaceous and Tertiary probably extend; but the Jurassic may be looked for over a narrow outcropping belt along the east side of the crest of the mountains." These observations are by one who has facts as a basis for his conclusions, and who admits a doubt until it is fully removed by investigation.

In conclusion, we would say that our reconsideration of the labors of Mr. Marcou in America has not raised our estimate of their value. We know well that if any American geologist had mapped out strata and synchronized those of America and Europe on such data as have satisfied the author of the "Geology of North America," he would have been deemed young in the science, with much yet to learn before he could have a sober hearing. We cannot, therefore, think that his former reviewers and opponents deserve, because they differ from him, either to have their names expunged from American geological history, or thrown into discredit; nor do we believe that their reputations will seriously suffer from the judgment of our ambitious Rocky Mountain explorer. Finally, our readers must be fully persuaded, that "Marcou's Geology of North America," is not "good authority,"—except with regard to the author and his style of work.

J. D. DANA.

ART. XXXVII.—*On the Tidal Currents of New York Bay, near Sandy Hook;* by A. D. BACHE, Superintendent United States Coast Survey.

(Communicated by authority of the Treasury Department.)

IN a former notice of the observations of tidal currents near Sandy Hook, I stated the general character of the results obtained, and their specific bearing upon the explanation of the growth of Sandy Hook, and of the changes above and below water in its vicinity. I propose now to describe more in detail the observations themselves, to discuss numerically and by the aid of diagrams the results obtained, and to show from them how the Hook is built up, the False Hook channel deepened, and Sandy Hook Bay modified in its shore line, and especially in the configuration of the bottom. Sketch No. 1 shows the current stations occupied on the outside of the Hook, and in False Hook channel and the approaches, in the different parts of the Main Ship channel and its approaches, and in the eastern, middle, and western portions of Sandy Hook Bay.

It will be convenient to discuss the subject under the three divisions already referred to of (1) the normal currents in the main ship channel and its approaches, of (2) the currents of False Hook channel and the approaches, and (3), the currents of Sandy Hook Bay.

1. *Normal Currents at the Entrance to New York Bay.*

Diagram 1, (sketch 1) shows the comparison of the average tidal currents at three groups of stations, the most eastern, comprehending the positions R_2 R, Q and H, shows the currents at and within the bar in the vicinity of Gedney's channel; the middle, embracing the stations P, O, I, A_2, A_1, lying for the most part between the eastern portions of Flynn's Knoll and the point of Sandy Hook, shows the currents of this part of the main ship channel; while the western group B and B_2 gives the currents for the western part of the main ship channel in the vicinity of the South West Spit. Diagram 1 (sketch 1) also exhibits the type form of the tide wave as observed at Sandy Hook. The currents are plotted for flood and ebb, above and below a common axis, which corresponds to the mean level of the sea. These curves are plotted in their true relative positions to the tide wave as regards their epochs.

Table 1 contains the *dates, names of stations, localities, luni-current intervals, durations, intervals after the tide wave, velocities and directions* of the currents. In this table are given the numerical results from all the stations to which we have referred, reduced to their

U. S. COAST SURVEY

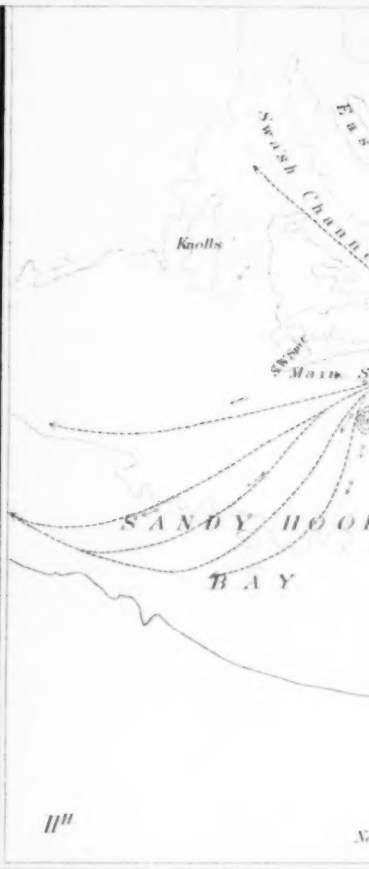
A. D. BACHE, Superintendent

Sketches Nos. 1 to 5.

Showing the set of currents in

SANDY HOOK BAY.

18 Feet curve .....



IIH

No 3.

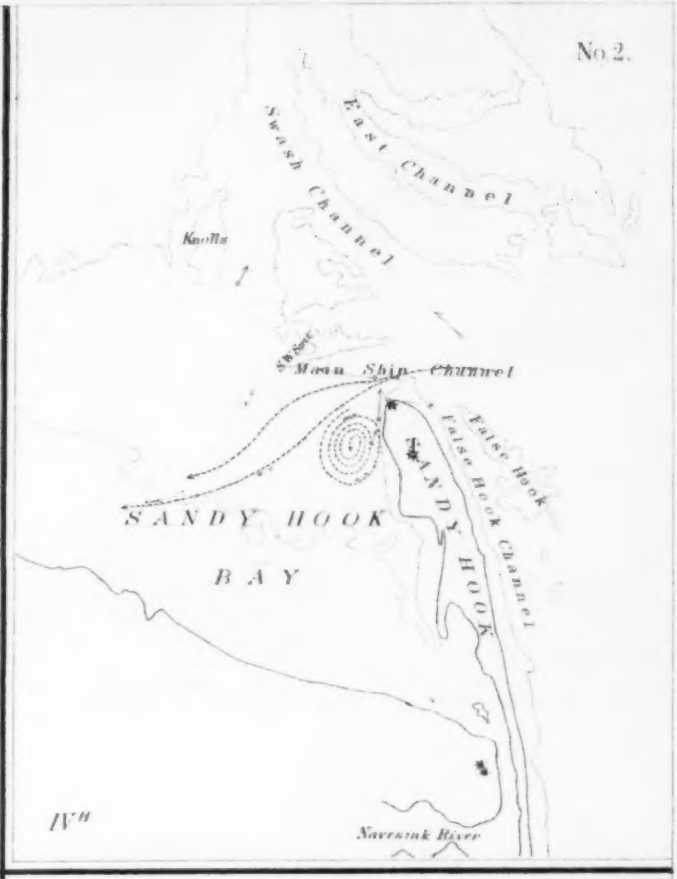
VH

IXH.

Drawn by W T Bright

No. 1.

No. 2.



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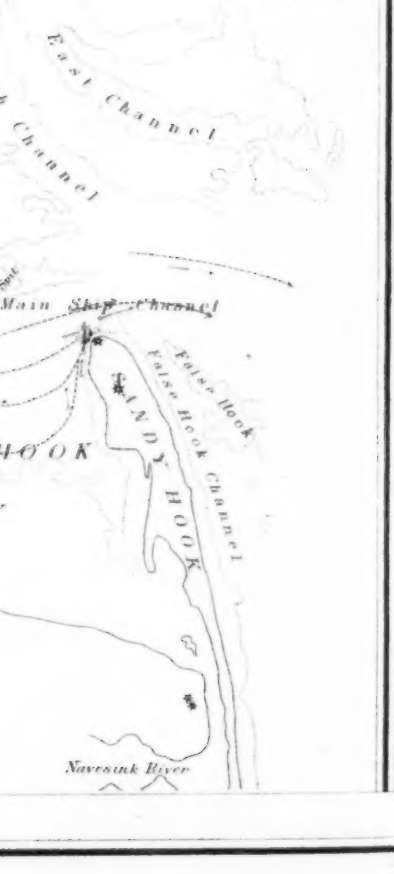

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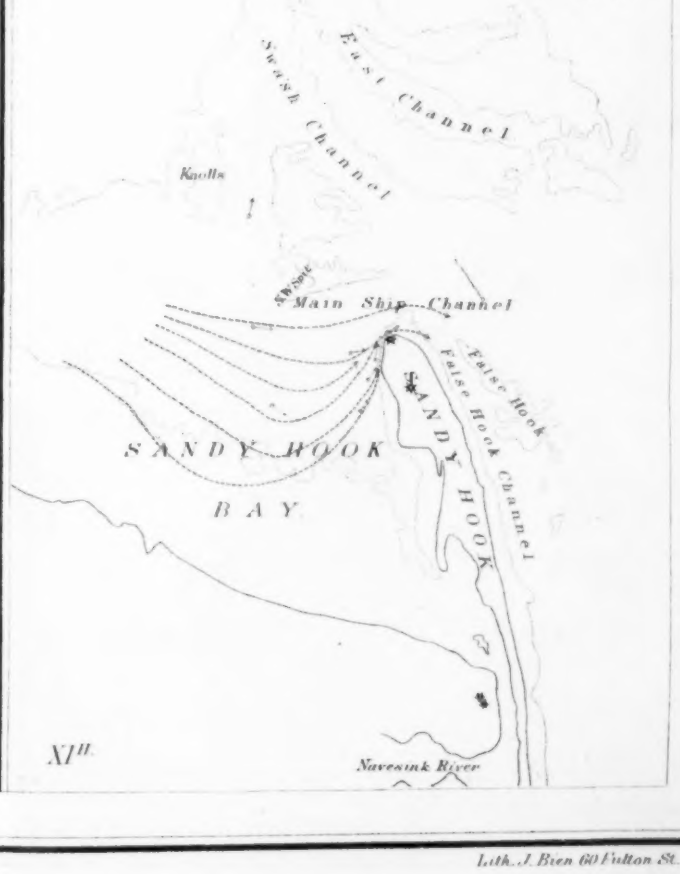


Lith. J. Bien 60 Fulton St. N.Y.

mean values. In table 2 the averages for the groups are given. From the first line of table 2 we find that about 56^m after the time of high water at Sandy Hook, the ebb current begins to make in the locality covered by the eastern group of stations, running east by south, reaching its greatest rate of about 1·71 miles per hour, (in about three hours), and then decreasing (in about three hours) to zero, and turning to flood at about $1^h\ 33^m$ after the time of low water, the ebb thus being estimated at $6^h\ 19^m$.

The flood reaches its maximum in about 3^h, when its rate is 1·11 miles per hour, running generally northwest for about $5^h\ 43^m$, and reaching slack water at about 56^m after the time of high water at Sandy Hook. The times of running ebb and flood are nearly equal. The greatest rates are as 17 to 11, and the average as 10 to 6.

Line 2 of table 2 gives the results from the middle group of stations, from which it appears, that in that portion of the main ship channel lying north of Sandy Hook, the ebb currents run generally east by south, the flood west by north. The ebb has a less velocity, and the flood a greater, than for the eastern group. The maximum velocity of ebb is 1·47 miles per hour, and of flood 1·68 miles. The mean velocities of ebb 1·09 and of flood 1·04 miles. The reason of this change of proportion between the maximum and mean velocities of the ebb and flood currents, is obvious from an inspection of the type curve. It will be seen that the ebb is characterized by a uniformity of rate during the second, third, and fourth hours of its existence, while the curve for the flood resembles the curve of sines. The ebb current turns earlier, lagging but 22^m after low water, thus turning more than 30^m before the corresponding currents to the eastward.

The 3d line of table 2 shows the results for the western group, in the vicinity of South West Spit. Here the currents have a course round the compass, are much less rapid than the others, and are earlier.

It would be curious to know where the earliest turning of the current is to be found, and, indeed, these results open up many questions in regard to the whole Bar and the channels through it. For our present purpose we have limited ourselves to obtaining the means of comparison of the normal currents sweeping by the point of Sandy Hook with those secondary ones which we shall next proceed to trace.

2. *False Hook Channel and the Approaches.*

The current stations S, T, C, D, G, F, and V, (see sketch 1), show the movements of the water in this channel and its vicinity, while stations at E, and "off Long Branch" lie quite to the southward. S, shows the action at the northern entrance, and V at the

southern, C in mid-channel. T at the entrance is influenced by the shoals of the False Hook. G, F, and V, between the ocean and False Hook channel are unsatisfactory. D shows the shore currents of Sandy Hook. The results from these stations are given in table 3, which is constructed in a manner similar to table 1, already described. Treating S, T, C, F, and G together as a group, we have for the luni-current interval $8^h\ 20^m$ or 58^m after the time of high water at Sandy Hook for the commencement of ebb, the current of ebb beginning earliest at S, G, T, the flood first at F, S, T. The interval of ebb is about the same as that of the vicinity of Gedney's channel, the flood three quarters of an hour earlier. This gives above a half hour for the difference of duration between the main ebb and flood, and the corresponding ones of this part of the approach to New York Bay.

The mean epochs (table 4) are $8^h\ 14^m$ and $14^h\ 02^m$, being 17^m and 46^m less than those found for the vicinity of Gedney's channel. The flood exceeds the ebb about 24^m, whereas for the stations near Gedney's channel the ebb exceeds the flood by about 34^m, and in the south channel the ebb has greatly the advantage both in duration and velocity. This shows the influence of the secondary or draught currents through the False Hook channel. The average maximum velocity at these stations of both flood and ebb is 1·41 miles, which last in the vicinity of Gedney's channel was 1·71 miles. The mean maximum velocity of the ebb is but 0·91 miles, which was 1·03 miles for the stations near Gedney's channel, and about the same at station S. The ebb makes out but slowly through the False Hook channel, the maximum velocity of the flood at C is 1·62 miles, and of the ebb but 0·78, and the means 1·02 and 0·50 miles per hour. The time during which the ebb runs is $5^h\ 41^m$, and the flood $7^h\ 08^m$, a difference of $1^h\ 27^m$, and this in the axis of the stream. As the scouring action of these currents may be regarded as varying with the product of the square of the mean velocity and the duration, we have for station C the ratio of about 1 to 5 for the relative work of ebb and flood. At the edge of the False Hook Shoal the duration of the ebb appears to be even less, there being but $5^h\ 20^m$ of ebb. The currents at C are plotted with the tide wave on diagram 3, (sketch 2). It appears that the curve representing the flood drift approaches the type form, while the ebb is anomalous —it is weak and inconstant. We are now prepared to find the shore currents such as the observations prove them to be. The results at station D, off the wreck of the brig Commerce, are shown in diagram 4, (sketch 2), where they are compared with the tide wave of July 18th. The flood runs for $7^h\ 15^m$ out of $12^h\ 42^m$. The greatest velocity of the flood is 1·23 miles against 0·62 of the ebb. The directions are nearly opposite. The cur-

rents "off Long Branch," off Ocean House, at station D, and at station 9, near point of Sandy Hook, are shown on diagrams 4 and 5, (sketch 2). The ebb currents are quite feeble in both. It is the shore current just discussed which transports materials to the end of Sandy Hook; it is the grand current, in fact, which makes the False Hook channel, and the False Hook occupies the debateable ground between the outside and False Hook channel currents at certain times of tide, and is built up by the slackening ebb. In this point of view the shoal tends to restore equilibrium. The difference of action of flood and ebb is defined by this shoal. At station V on the southern extremity of the outer middle ground, and in close proximity to the lower entrance of False Hook channel, the currents are feeble, and an equilibrium of ebb and flood drifts seems to be established. It would appear that the scouring action of the tidal currents is insufficient to keep the bar of this channel open.

It is the material carried along the outer shore of Sandy Hook, and deposited at the point, which chiefly causes the growth of the Hook. Whenever it shall be considered desirable to limit this increase it will be easy to do so, by a series of jetties so placed as to arrest the movement of the sand to the northward, successive structures stopping the material which may pass round the point of the more southwardly jetties.

3. *Currents of Sandy Hook Bay.*

To obtain a clear idea of the tidal currents of Sandy Hook Bay, let us suppose it divided into three sections, eastern, middle, and western, and ascertain the relations of direction at successive periods. To this end we arrange the results according to the twelve tidal hours, calling the epoch of low water 0^h, the epoch of high water 6^h, &c.

The flood current commences in the main ship channel and in Sandy Hook Bay at nearly the same period, viz., about $1^h\ 04^m$ after the time of low water. The water of the main ship channel now flows to the westward, that of the eastern section of the Bay to the southward, that of the middle to the southwest, and that of the western section to the west. This general condition continues for about two and a half hours, and is exhibited upon diagram 1, (sketch 3). It will be noticed upon this diagram, that a limited region about the point of Sandy Hook is subject to a counter drift or whirl. This whirl is increasing in size, and its axis is moving southward; its existence is due to the lateral draught produced by the strong and steady stream of the ship channel, to which we shall refer hereafter. At 3^h the effect of this lateral draught on the eastern section is already seen in the slacking up of the currents, and at 4^h it has completely reversed the direction of the drifts. At this period, 4^h, the conditions are

exhibited by diagram 2, (sketch 3). The currents are northward, (with velocities of 1·4 and 0·3 miles per hour, at stations near to and more remote from the main ship channel), in the eastern, southwestwardly (with velocity 0·3) in the middle; and westwardly (with velocity 0·4) in the western section of the Bay, while the current of the main ship channel now at its maximum, holds a course due west, with a velocity of 1·9 miles per hour. Later still, we find this whirl, heretofore elliptical, assuming a more circular form. At 5^h it has extended to the middle section of the Bay, reversing the currents of that region, (see diagram 3, sketch 3). Its axis still moves to the southward, and at 6^h there occurs a space of slack water, near the point of Sandy Hook, where we at first noticed the existence of the whirl that we have followed. The currents are now diminishing rapidly in the main ship channel, as well as in the western section of the Bay, and at 7^h we find the ebb current prevailing. At first the course of the ebb currents of Sandy Hook Bay may be represented by straight lines converging to a point, in the ship channel north of Sandy Hook, but these lines of direction gradually curve to the southward, until as in diagram 4, (sketch 3), (which represents the conditions at the 9th hour) the waters of Raritan Bay press into Sandy Hook Bay, then, escaping along the shore of Sandy Hook, rush into the ship channel, causing a rip and counter drift at the point of the Hook. At this time (9^h) the current of the main ship channel runs east (velocity 1·3 miles per hour), that of the eastern section of the Bay, north, (velocity 0·5), that of the middle east by south, (velocity 0·5), and that of the western, east by south, (velocity 0·2).

The point of greatest curvature, in the sweep of the ebb drift through Sandy Hook Bay, moves continually to the westward, as will be seen by comparison of the conditions at 9^h and 11^h, (see diagrams 4 and 5, sketch 3). This grand movement ultimately creates a counter drift near the point of the Hook, which assumes the form of a whirl as the current of the ship channel slackens. The ebb (northwardly) is the dominant current in the eastern section of Sandy Hook Bay; it commences to prevail three hours before the flood of the ship channel slackens. It is evident that this earlier drift is the lateral draught created by the stream of the ship channel, since as we have previously shown, its domain increases with the velocity of the main stream, and it prevails generally in the eastern section of the Bay, when the main stream has reached its maximum velocity. Moreover, our several stations show that the duration and velocity of this northwardly drift are alike dependent upon the distance from the ship channel.

Lines 1 and 4 of table 6 give the averages of the maximum velocities at several stations as 1 mile of ebb against 0·4 of flood,

and the mean velocities 0·6 of ebb against 0·2 of flood. The mean durations are more than 10 hours of ebb against less than 2 hours of flood.

In the middle of Sandy Hook Bay the ebb current begins nearly two hours before slack water in the main ship channel, its general course is south by east, that of the flood being east by north. The average maximum velocities, given by the 5th line of table 6 are 0·6 of ebb, against 0·4 of flood; the mean rates are above 0·4 of ebb against 0·2 of flood. The durations are about $8\frac{1}{4}$ hours for ebb and $3\frac{1}{2}$ for flood. In the western section of the Bay the ebb commences at nearly the same period as in the main ship channel. The average velocities are nearly equal, and the durations are more nearly so than for the other portions of the Bay. The scouring done by these currents will vary with the product of the duration and the square of the mean velocity, if the material to be acted upon is the same. In the eastern section, therefore, the work done by the ebb is to that done by the flood as 45 to 1. In the middle section the work done by the ebb and flood will be as 9 to 1, while in the western section the feeble labors of ebb and flood are nearly equal, and their directions so nearly opposed that little ultimate scouring is effected. The form of the bottom is in accordance with these results.

Since the tide wave is propagated most rapidly in deep water, it follows that the fall of the tide takes place earlier in the channel than upon the shore; hence the water tends to flow laterally from the shore toward the channel. In this way a convergence of the ebb streams may be expected, especially in shallow bays. With the flood streams the reverse must be true, and the tide wave, rising earlier in the channel, a flow of water takes place toward the shore. In consequence of these distinctive characteristics, the ebb and flood assume an unequal share in the moulding of sandy coasts. The ebb current, with its concentration of forces, is a far more powerful agent than the flood, its scouring capacity along its normal course must be more considerable, and it creates more extensive draught currents. The secondary or draught currents within Sandy Hook, called into activity by the unnaturally constrained flood of the ship channel, cover a district not above one and a half miles in extent, while the draught of the ebb upon the outer shore is sensibly felt twelve miles down the New Jersey coast, it is felt at Long Branch where the primary ebb and flood are almost extinct.

Again, the ebb stream holds its course across the middle of shallow basins, in a narrow stream, while the flood, dispersive in its character, pursues the broadest possible path, and presses along the shores. We are prepared, therefore, even in the absence of draught currents, to find the flood predominating over the ebb

in certain localities near the shore. It is not probable that the axis of the grand ebb current has moved northward to avoid Sandy Hook, but rather that it naturally converges at the mouth of New York Harbor, and that the weaker flood has not been able to destroy the work which the ebb has *directly or indirectly* accomplished. It is true that the flood at the point of the Hook is sweeping the sand inward—that in fine it is giving this spit of land *the hook form*—but the ebb is the primary working agent, and the characteristic features of all channels, and basins, on alluvial tidal coasts, must, as a rule, reflect the efforts of the ebb current. That part of the growth of the Hook which takes place from the inside, and which is not so considerable as that from the outside, is caused by the draught current along the shore, which we have been engaged in studying. The action of the waves undoubtedly contributes by the standing of the materials to this growth. The material on the inside is less favorable to the action of transportation, and the currents are lost at a moderate distance from the extremity of the Hook.

TABLE No. 1.

Date. 1856.	Station.	Locality.	Lunar Current Interval.		Duration of Current.			Interval after tide of S. Ho'k		Velocity of currents in nautical miles per hour.				Direction of Current.			
			Ebb.	Fl'd.	Tot'l	Ebb.	Fl'd.	Ebb aft'r h w	Fl'd aft'r l. w.	Maxim'm		Mean.		At maximum.		General.	
										Ebb.	Fl'd.	Ebb.	Fl'd	Ebb.	Flood.	Ebb	Flood
			H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	Mn Dec.	Mn Dec.	Mn dec	Mn dec.				
Aug. 2	R	W. end of Gedney's Channel.	8 32	14 53		6 21		1 05	2 10	2·14	1·15	1·22	0·47	E. by S.	N. W.	E. by S.	N.W.
"	Q	Betw'n R. & P.	8 42	14 47		6 05		1 15	2 04	2·17	1 15	1·11	0·80	E.	W. N. W.	E.	N.W. by W.
July 13	R_2	E. end of Gedney's Channel.	8 47	14 57	12 30	6 10	6 20	0 55	0 55	1·15	0·74	0·70	0·57				
" 23	H	Junction of Swash and Gedney's Channel.	8 02	14 36	12 31	6 34	5 57	0 30	1 04	1·37	1·42	1·10	0·72	E. by S.	N. W.	S. E.	N.W.
Aug. 1	P	S.E. of Flynn's Knoll.	7 48	14 48		7 00		0 20	1 19	1·90	1·42	1·15		E. N. E.	W. N. W.	E. by N.	N.W. by W.
"	O	Main Ship Channel near Flynn's Knoll.	8 18	14 23		6 05		0 50	1 27	1·02	1·53	0 80	0·86	E.	N. W.	E.	N.W. by W.
July 15	A_1	Main Ship Channel N. of E. beacon.	8 30	15 25	12 00	6 55	5 05	0 16	1 09	1·32	1·90	1·02	1·15	E. by S.	W.	E. S. E.	W.
" 23	I	Near O.	8 12	14 35	12 23	6 23	6 00	0 15	0 37	1·63	1·50	1·39	1·10	E. by S.	W. by N.	E. by S.	W. by S.
" 15	A_2	Middle of Ship Channel.	7 43	14 31		6 48		0 11	0 36		2·07				W. by N.		W. by S.
" "	B_2	S. of S.W. Spit.	7 46	14 16	12 08	7 08	5 00	—10	1 00	1·12	0·43	0·47	0·26	E.	N.W. by W.	round the compass.	
" 16	B	Near B_2.	8 12	15 58													

TABLE No. 2.

R, Q, R_2, H,	8 31	14 48	6 17	0 56	1 33	1·71	1·11	1·03	0·64			E. by S.	N.W.
P, O, A_1, I, A_2,	8 06	14 44	6 38	0 22	1 04	1·47	1·68	1·09	1·04			E. by S.	W. by S.
B_2, B,	7 59	15 07	7 08	—10	1 00	1·12	0·43	0·47	0·26	round the compass.			

Note.—The minus sign is used to indicate that the slack current precedes the stand of the tide wave.

Table No. 3.

Date. 1856.	Stations	Locality.	Luni current Interval.		Duration of current.			Interval after tide of Sandy Hook.		Velocity of Current.				Direction of current.				
										Maximum.		Mean.		At maximum.		Mean.		
			Ebb.	Fld.	Total.	Ebb.	Fld.	Ebb after h. w.	Flood after l. w.	Ebb.	Fld.	Ebb.	Fld.	Ebb.	Fld.	Ebb	Fld.	
			H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	M. dec.	M. dec.	M. dec.	M. dec.					
July 15	U	S. channel E. of main Lt.	8 34	15 41	13 17	7 07	6 10	20	1 25	1·30	1·00	0·71	0·52					
" 18	C	Middle of False Hook Channel,	8 28	14 09	12 49	5 41	7 08	50	25	0·78	1·62	0·50	1·02	S.E.	N. by W.			
" 21	F	W. side Oil Spot,	8 28	13 48		5 20		1 08	28	0·62	0·95	0·35	0·60	S.S.E.	N.W.	S.E.	N.W.	
" 21	G	E. side Oil Spot,	8 11	14 09		5 58		1 10	55	1·04	1·14	0·73	0·62	S.E. by S.	N. by W.	S.E.	N. by W.	
" 24	9	E. of Stake No. 19,	7 07	10 36		3 29		− 25	−3 05	0·35	1·01	0·20	0·40	S.E.	N.W. by N.	S.E.	N.W.	
" 18	D	E. Main Lt., 500 feet from shore,	8 02	13 29	12 42	5 27	7 15	30	− 20	0·62	1·23	0·15	0·72	S.	N.	S.	N. by W.	Shore currents from N. end of Sandy Hook to Long Branch, N.J. in 12 to 18 feet of water.
" 18	E	Off Ocean House, 500 feet from shore,	7 37	11 46	12 09	4 09	8 00	1 15	−2 30	0·17	0·15	0·12	0·07	S.	N.	S.	N.	
" 21		Long Branch 500 feet off shore,	10 42	11 49	11 07	1 07	10 00	3 28	−1 25	0·10	0·15	0·01	0·03	S.S.W.	N. by E.	E.	N.	
Aug. 4	S	Outside False Hook, N. end,	8 09	13 55		5 46		40	50	1·77	1·64	1·06	1·10	S.E.	N.W. by N.	S.E.	N.W. by N.	
" 4	T	S. E. of station S,	8 22	14 03		5 41		1 00	55	1·44	1·44	0·05	·86	S.E.	N.W.	S.E	N.W. by N.	
July 19	V		8 09	14 31	12 22	6 22	6 00	−0 20	1 00	0·20	0·20	0·10	0·12					

Table No. 4.

S, T, C, F, G,	8 20	14 01		5 41		0 58	0 43	1·13	1·36	0·72	0·84			S.E.	N.N.W.
U, South Channel E. of main Lt.,	8 34	15 41	13 17	7 07	6 10	20	1 25	1·30	1·00	0·71	0·52				
G, S, T,	8 14	14 02		5 48		0 57	0 53	1·41	1·41	0·91	0·86			S.E.	N.W. by N.

Note.—The minus sign is used to indicate that the slack current precedes the stand of the tide wave.

TABLE No. 5.—*Velocities corrected for diurnal and half monthly inequalities.*

Date 1856.	Station No	Locality.	Lunar current Interval. Ebb.	Fld	Duration of current. Total	Ebb.	Fld.	Interval after tide of Sandy Hook. Ebb after h. w.	Flood after l. w.	Velocity of currents in nautical miles per hour. Maximum. Ebb.	Fld.	Mean. Ebb.	Fld.	Direction of current. At maximum. Ebb.	Fld.	General. Ebb.	Fld.	Depth in feet.	
			H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	M. dec.	M. dec	M. dec.	M. dec.						
	7	Near end of Hook 200 ft. off shore,	3 30	14 51	12 21	11 21	1 0	−4 15	1 15	1·40	0·23	0·58	0·12	N.N.E.	N. by W.	N. by E.	N.W.	28	Shore currents.
	6	500 ft. S. of station 7, 200 feet off shore.	3 18	14 37	12 24	11 19	1 5	−4 20	0 35	1 57	1·02	1·09	0·57	N.E.	S.W.	N.E.	S.W.		
	5	Off W. Beacon, 600 ft. and 400 ft. from shore,	5 07	14 42	13 45	9 35	4 10	− 40	− 30	0·78	0·46	0·46	0·21	N.N.W.	S.	N.N.W.	S.	6	Inside Sandy Hook, N.J.
	4	Off Tide gauge, W. of Lt. House,	4 20	14 59	13 14	10 39	2 35	15	−2 50	0·78	0·15	0·43	0·11	N. by E.	S.E. by S.	N.	S.E.	7	
	K	2200 ft. off shore, S. W. of W. Beacon,	5 23	14 18	12 25	8 55	3 30	− 30	0 20	0·43	0·54	0·30	0 35	N. by E.	S.	N. by E.	S.	12	
	L1	3600 ft. off shore, W. of Lt. House,	4 32	14 19	12 12	9 47	2 25	−3 08	0 40	0·76	0.21	0·44	0·05	N.N.E.	S. by W.	N.N.E.	S.	24	Eastern portion Sandy Hook Bay.
	L2	1200 ft. S. W. of L1,	5 09	14 34	11 36	9 26	2 10	−3 25	0 40	0 61	0·35	0·39	0 16	N. by E.	S. by E.	N.	S. by E.	24	
	M1	W. of Lt. Ho., middle of S. H. Bay,	5 28	14 27	11 39	8 59	2 40	−2 40	0 40	0·50	0·23	0·32	0·07	N.	S.	N.	S.	25	
	M2	2000 ft. N. E. of M1,	6 38	14 29	12 02	7 51	4 11	−1 50	1 45	0 32	0·69	0·43	0·26	N.E.	E.S.E.	N.E.	E.S.E.	25	Middle of S. Hook Bay.
	M3	2000 ft. N. of M1,	5 58	14 42	11 24	8 44	2 40	−1 50	1 40	0·80	0·47	0·45	0·15	E. by N.	S.E.	E. by N.	S.E.	27	
	N1	W. of Lt. Ho., North of Port Monmouth,	6 10	14 29	11 49	8 19	3 30	−1 45	00	0·78	0·16	0·45	0·03	E.S.E.	S.W.	E. S. E.	S.W.	30	
	N2	Between N1 and N2,	8 23	14 43		6 20		−0 35		0·30	0·52			S.E.	W.	E.	W.	18	Western portion Sandy Hook Bay.
	N2	N. end of Port Monmouth Dock,	7 45	14 29	12 54	6 44	6 10	0 35	− 20	0·36	0·42	0·17	0·21	E. by N.	W. by N.	E.	W.	30	
			7 58	13 52	13 24	5 54	7 30	0 10	−1 35	0·26	0·46	0·17	0·23	N.E.	W.N.W.	N.E.	W.	8	

TABLE No. 6.

Nos.													
7 and 6	3 24	14 44	12 22	11 20	1 02	−4 18	55	1·49	0·63	0·83	0 34	N. by E.	W.	28	N.E. portion S. Hook Bay.
5	4 43	14 50	12 29	10 07	3 22	− 12	1 40	0·78	0 30	0·44	0·16	N. by W.	S. by E.	6	Shore currents Sandy Hook.
4	5 23	14 18	12 25	8 55	3 30	− 30	0 20	0 43	0·54	0·30	0·35	N. by E.	S.	12	
K, L1, L2	5 05	14 27	11 47	9 22	2 25	3 04	40	0 62	0·27	0·38	0 09	N.	S.	24	East'n portion of S. H. Bay.
M1, M2, M3	6 16	14 33	11 47	8 17	3 30	−1 47	1 08	0 63	0 44	0·44	0·15	E. by N.	S. by E.	27	Middle portion of S. H. Bay.
N1, N2, N3	8 02	14 22	13 10	6 20	6 50	0 03	0 58	0 30	0·47	0 17	0·22	E. by N.	W.	18	West'n portion of S.H. Bay.

NOTE.—The minus sign is used to indicate that slack current precedes the stand of the tide.

ART. XXXVIII.—*On a Supposed Personal Equation in the Use of the Zenith Telescope for Determining Latitudes by Talcott's Method;* by A. D. BACHE, Superintendent U. S. Coast Survey.

(Communicated by authority of the Treasury Department.)

THE use of the zenith telescope to determine latitudes for the Coast Survey by Talcott's method has been explained in a paper read before the Association at the Cincinnati meeting in 1851. The difference of zenith distance of two stars passing the meridian nearly at the same time, one north and the other south of the zenith, and at nearly the same distance from the zenith, is measured by a micrometer. The sum of the same distance is given by the star catalogue, whence the zenith distances of each star of the pair becomes known, and from its declination the latitude of the place.

Observations at Mount Sebattis Station in Maine, in 1853, seemed to show that this method was not free from personal equation, either of observer or instrument. The same twenty-three pairs of stars observed with zenith telescopes No. 1 by assistant J. E. Hilgard, and No. 2 by sub-assistant J. G. Ottmanns, gave results differing by 1″·12, the probable accidental error of one value of the difference being ± 0″·77, and that of the mean ± 0″·16. The probable accidental error of one observation was ± 0″·81 with the first, and ± 1″·14 with the second observer, hence for the mean of each pair, with an average number of three observations on each, the probable errors would be ± 0″·48 and ± 0″·66 respectively, and for the difference of two such means ± 0″·81, scarcely differing from the value above stated, which is derived from a comparison of the differences among themselves.

The residual difference of 1″·12 appears, therefore, in the light of a constant quantity, and there being thus cause to suspect that identical results might not be obtained by two observers, or by two different instruments, a plan of observation was laid out for settling the question.

At the telegraph station, Columbia, S. C., in 1854, assistants B. A. Gould, Jr., and G. W. Dean, observed with zenith telescopes No. 2 and No. 5. The latitude found by Mr. Dean with both instruments was almost identically the same, being with No. 2 33° 59′ 58″·14, and with No. 5 33° 59′ 58″·10, with probable errors from twenty-one pairs of stars, with the two instruments respectively of ± 0″·14 and ± 0″·16. With the same instruments and from the same stars, Dr. Gould obtained 33° 59′ 58″·30 ± 0″·18, and 58″·13 ± 0″·18. The inquiry was continued at Ragged Mountain station, Maine, in 1854, by assistant G. W. Dean and sub-assistant Stephen Harris, under my direction, using the same instruments and observing the same pairs of stars. The resulting latitude from observations on thirty-two pairs of

TABLE No. 5.—*Velocities corrected for diurnal and half monthly inequalities*

stars was absolutely identical, with a probable error of $\pm 0''.11$ for the result by either observer. A further trial with zenith telescopes No. 10 and No. 2 at Mount Harris station, Maine, by assistant Dean and sub-assistant Goodfellow, under my direction, in which Mr. Dean used both instruments, and Mr. Goodfellow No. 10, gives latitudes differing very slightly. Mr. Dean obtained using zenith telescope No. 10, $44° 39' 54''.49$, and by No. 2, $54''.76$, while Mr. Goodfellow using No. 10 obtained $54''.83$. The corresponding probable errors of the mean latitudes from thirty-three pairs of stars were $\pm 0''.14$, $0''.13$, and $0''.13$. Finally, at Mount Desert station, Maine, a comparison was made by sub-assistants Edward Goodfellow and Stephen Harris, using zenith telescope No. 5, and observing the same pairs of stars. The latitudes obtained from observations on thirty pairs of stars differed but two hundredths of a second, with probable errors of $\pm 0''.13$ and $\pm 0''.14$.

The investigation has thus clearly proved that there is no personal equation of observer or instrument in the use of the zenith telescope by Talcott's method, but that identical results can be obtained by different observers, with the same or different instruments using the same pairs of stars for observing. The accuracy, of the final result, depends therefore, upon the accuracy of the declinations of the pairs of stars, upon the use of the proper number of pairs, and upon the care taken in determining the values of the micrometer and level divisions, and in using the instrument. A probable error in observing of from $\pm 0''.25$ to $\pm 0''.80$ may be expected for one observation, according to the size and quality of the instrument and the ability of the observer. The probable error of the result by a single pair of stars as depending on the catalogue errors of the stars places, will range from $\pm 0''.60$ to $\pm 1''.00$, which will give from $\pm 0''.11$ to $\pm 0''.18$ for the latitude as resulting from thirty pairs. The discrepancy in the results obtained at Sebattis may possibly be owing to the warping of the thin ledge of rock on which the instruments were mounted. The unusually large value of the accidental error of observation seems to indicate some disturbing influence.

The following table contains a recapitulation of these results. The first column gives the name of the station at which the observations were made—the second, the date—the third, the instrument—the fourth, the observers name—the fifth, the number of pairs observed—the sixth, the resulting latitude—the seventh, the probable error of the result—the eighth, the probable error of the result by a single pair of stars, derived from a comparison of the mean latitude with the result by each pair,—and the ninth, the probable accidental error of one observation, derived from a comparison of the individual results for each pair of stars with their respective means:

Table showing Results of Observations for Personal Equation in Determining Latitudes by Talcott's Method.

Station.	Date.	Zenith telescope.	Observers.	No. of pairs of Stars.	Latitude.	Prob. error of resulting Latitude.	Prob. error of result by single pair.	Prob. accid. error of one obser.
						±	±	±
Mt. Sebattis.	June, 1853.	No. 1	J. E. Hilgard.	23	44° 08′ 37″·82	0″·16	0″·90	0″·81
		" 2	J. G. Oltmanns.	23	38″·94	0″·22	1″·08	1″·14
Columbia.	Feb. 1854.	No. 2	G. W. Dean.	21	33° 59′ 58″·14	0″·14	0″·62	0″·36
		" 5	do.	21	58″·10	0″·16	0″·75	0″·25
		" 2	B. A. Gould.	21	58″·30	0″·18	0″·83	0″·
		" 5	do.	21	58″·13	0″·18	0″·83	0″·
Ragged Mt.	Oct. 1854.	No. 5	G. W. Dean.	32	44° 12′ 42″·79	0″·11	0″·62	0″·25
		" 5	S. Harris.	32	42″·79	0″·11	0″·65	0″·47
Mt. Harris.	Aug. 1855.	No. 10	G. W. Dean.	33	44° 39′ 54″·59	0″·14	0″·79	0″·29
		" 2	do.	33	54″·76	0″·13	0″·73	0″·37
		" 10	E. Goodfellow.	33	54″·83	0″·13	0″·74	0″·44
Mt. Desert.	Aug. 1856.	No. 5	E. Goodfellow.	30	44° 21′ 06″·37	0″·13	0″·71	0″·41
		" 5	S. Harris.	30	06″·39	0″·14	0″·76	0″·46

Art. XXXIX.—*Sixth Supplement to Dana's Mineralogy;* by the Author.

List of Works, etc.

R. P. Greg, F.G.S., & W. G. Lettsom: Manual of the Mineralogy of Great Britain and Ireland. 484 pp., 8vo, with numerous wood-cuts. London, 1858.—An important contribution to the science, containing detailed descriptions of species and localities, and new forms of crystals, etc.

James Nicol: Elements of Mineralogy, London, 1858.

A. Wyley: Report upon the Mineral and Geological Structure of South Namaqualand and the adjoining Mineral Districts. London, 1857.

Henry James Brooke: On the Geometrical Isomorphism of Crystals. 42 pp. 4to. From the Transactions of the Roy. Soc. of London, 1857. Mr. Brooke has here treated of the subject discussed in the writer's Mineralogy, i, 191–205, in 1854.

W. H. Miller (Prof. Min. Univ. of Cambridge): On the Anharmonic ratio of Radii normal to four faces of a crystal in one zone, and on the Change of the Axes of a crystal. Also on the Application of Elementary Geometry to Crystallography. —Philosophical Magazine for February and May, 1857.

W. H. Miller: An improved method of finding the position of any face in crystals belonging to the Anorthic system.—Phil. Mag., [4], xv, 512.

A. Damour: Recherches sur les Propriétés hygroscopiques des Minéraux de la Famille des Zéolithes. Annales de Chimie et de Physique, [3], liii, 438, Aug. 1858.

C. Boedeker: Die Zusammensetzung der Naturlichen Silicate: ein Beitrag zur Mineralogie und Chemie. 136 pp., 8vo. Göttingen, 1857.

Prof. Dr. Jos. Grailich: Krystallographisch-optische Untersuchungen. Eine von der Kaiserl. Akad. der Wissenschaften am 30 Mai 1857 *Gekrönte* Preisschrift. 236 pp., 8vo, with numerous wood-cuts. Vienna and Olmutz, 1858.—A work of high merit and value, treating of the optical characters of numerous artificial crystals and native minerals, and the modes of optical investigations.

K. J. KREUTZER: Leichtfassliche Anleitung zum Zeichen der Kristall-Flachen und Netze, und zur Anfertigung der Kristallmodelle aus Pappe. 146 pp. 8vo, with an atlas of 10 plates in 4to. Wien.—A work on the determination of the forms of the faces of simple and complex crystals, and the mode of making crystal models out of paper.

Dr. F. X. M. ZIPPE: Die Charakteristik der naturhistorischen Mineral-System, als Grundlage zur richtigen Bestimmung der Species des Mineralreiches. 250 pp., 8vo. Wien.—This volume contains an exposition of the so-called "natural-history" or Mohsian system of minerals, followed by an arrangement according to it of the species, with brief descriptions.

FRIEDERICH HESSENBERG: Mineralogische Notizen. 32 pp. 4to, with 3 plates of figures of crystals; also Fortsetzung (continuation) of the same, 24 pp. 8vo, with 2 plates.—The figures are excellent, and represent many new forms of crystals.

LIEBENER: Die Mineralien Tyrols. 1857.

C. U. SHEPARD: Report on the Pascoe Gold Mine. 16 pp. 8vo. New Haven.—This mine lies in the auriferous belt which extends for 300 miles southwest (South 40° W.) from Macon Co., North Carolina, through Rabun, Habersham, Lumpkin, Dawson, Forsyth, Cherokee, Cass, Polk, Paulding and Carroll Cos., Georgia, and thence across Cherokee, Kendall and Tallapoosa in Alabama. It is for the most part parallel to the southeastern mountain range of the Blue Ridge. The rocks are hornblendic and mica schist with interlaminated quartz, gneiss and talcose slate; they dip 70° to 80° to the southeast. The gold occurs in the interlaminated quartz, and mostly in pyrites. The pyrites is seldom in distinct crystals, and decomposes rather easily; it sometimes constitutes one-fourth of the vein. The associated minerals are magnetite, hematite, ilmenite, chalcopyrite, argentiferous galena, rutile, tetradymite (rare), magnesian garnet, ores of manganese. Garnet, staurotide, kyanite, occur in the mica schist; spodumene is abundant in granite, and with it occur small crystals which appeared to be tin ore.

C. U. SHEPARD: Report on the New Bangor Slate Quarry in Polk Co., Georgia 12 pp. 8vo.

Descriptions of Species.

ALBITE [p. 240].—The albite crystals from Col du Bonhomme, Mont Blanc, according to Hessenberg (Min. Notizen, p. 8), are compounded parallel to the clinodiagonal section, by both the methods illustrated in figures 415 and 416 in the Mineralogy. There is also composition in other crystals parallel to $i\text{-}\bar{1}$ or the macrodiagonal section. Hessenberg also mentions the new plane $\frac{3}{2}'$ in the albite crystals of Sterzing.

ALLANITE [p. 208, and I, II, III, IV, V].—Occurs with lanthanite at the Sanford ore bed (of magnetic iron), Moriah, Essex County, New York, chiefly along the plane of junction of the ore with the granite walls. The crystals are of large size, some of them eight or ten inches long, six or eight broad, and one to two thick. Apatite is found at the same place in reddish brown crystals. W. P. Blake in this volume, p. 245.

ALUMIAN, *Breithaupt.*—According to Breithaupt's description, (Berg. u. hütt. Zeit., xvii, 53,) alumian is an anhydrous sulphate of alumina, from mines in the Sierra Almagrera, in Southern Spain. Crystals microscopic and probably rhombohedral; traces of cleavage; H.=2—3; G.=2·702—2·781; lustre of small crystals vitreous, of masses weak; color white; subtranslucent.

By Utendörffer's determinations, it contains 37 or 38 per cent of alumina, along with sulphuric acid. Regarding the whole as $\dot{S}$, the compound is $\dot{A}l\dot{S}^2$=sulphuric acid 60·91, alumina 39·09. BB. unaltered; only hygroscopic water is given off.

ALUNOGEN [p. 381, and III].—Alunogen from Puster valley in the Tyrol, afforded L. Barth (Sitz. Akad. Wien, xxiv, 289):

$\dot{S}$ 36·0	$\dot{A}l$ (with traces of iron) 15·8	$\dot{H}$ 48·4

whence the usual formula $\dot{A}l\dot{S}^2+18\dot{H}$.

ANALCIME.—See *Leucite.*

ANORTHITE [p. 234, and II].—New figures of anorthite from Vesuvius are given by F. Hessenberg (Min. Notizen, p. 6), in which there are the new planes $-1'$, $i\text{-}\bar{i}$, $\frac{1}{2}\bar{1}'$, $6\text{-}\bar{i}$.

An analysis of anorthite from the diorite of the Urals, by R. H. Scott, Esq., is given in the Phil. Mag., [4], xv, 518.

APATITE [p. 396, and I, II, III, IV, V].—Crystals of a blue color, called Lazurapatite, occur with lapis lazuli at Bucharei in Siberia according to N. Nordenskiold (Bull. Nat. Moscow, 1857, 224).

ARÆOXENE [p. 364, and IV under Dechenite].—Analysis by C. Bergemann (Leonh. u Bronn, 1857, 397) of the arœoxene from Dahn:

Ṽ	Ās	Ṗb	Żn	Ẍl, Ḟe	Ṗ	
16·81	10·52	52·55	18·11	1·34	*trace.*	= 99·33. G.=5·79.

No allusion is made to the identity of arœoxene and dechenite, a fact suggested by Dr. Krantz, and sustained by a qualitative analysis published in Supplement IV.

ASPHALTUM [p. 469].—A large deposit of asphaltum occurs in Tschetschna between Terek and Argun (J. f. pr. Chem., lxxiii, 232).

AUERBACHITE, *Hermann.*—Hermann has described under this name (after Dr. Auerbach) a mineral from Mariupol, near zircon in form and composition (J. f. pr. Chem., lxxiii, 209). It is dimetric, with the angle at the basal edges of the pyramid, 86° 30′ to 87°, and at the pyramidal edges 121°. Color brownish gray; lustre weak, greasy; H.=6·5; G.=4·06. Infusible alone, but fuses with hydrated potash. Composition—

S̈i	Żr	Ḟe	ign.	
42·91	55·18	0·93	0·95	=100,

giving the oxygen ratio of 1 : 1·5. This different composition, less hardness and specific gravity and greater fusibility with potash, distinguish it from zircon [and suggest that it may be an altered zircon, in which part of the zirconia has been removed.]

BAIKERITE, *Hermann.*—A chocolate-brown mineral wax from the vicinity of Lake Baikal (J. f. pr. Chem. lxxiii, 230), of the hardness of wax, but becoming soft with the warmth of the hand; fuses at 52° C. to an oily liquid, and at a higher temperature distils over, leaving a little of a carbonaceous residue. Dissolves in hot ether, naphtha and turpentine. Attacked by alcohol. In 100 parts there are

Wax-like substance insoluble in alcohol,	7·02
" " soluble "	60·18
Thick fluid resin,	32·41
Earthy impurities,	0·39
	100·00

BARYTES [p. 366, and II, V].—A pseudomorph after calcite of the form R^3 (scalenohedron) has been observed at Przibram (Hessenberg, Min. Not. Forts., 23).

BIEBERITE [p. 385].—Bieberite occurs at Tres Puntos, near Copiapo, Chili (W. J Taylor, this vol., p. 134).

BIOTITE [p. 225, and in Suppl. under Mica].—A black mica from Pfitsch in the Tyrol, having G.=2·94, afforded F. Bukeisen (Sitz. Akad. Wien, xxiv, 285):

S̈i	Ẍl	Ḟe	Ṁg	K̇	Ḣ	Ċa, Mn, Fl	
38·43	15·71	13·04	17·28	11·42	2·76	*trace*	= 98·64

BRAUNITE [p. 117].—An impure braunite from a serpentine rock in Engaddin, having G.=3·5, has been analyzed by Bukeisen (Sitz. Akad. Wien, xxiv, 287).

BROOKITE [p. 123, and II, IV].—Pseudomorphs of brookite after sphene are found, according to A. Müller (Verh. Nat. Ges. Basel, 4th Heft, 1857, p. 573), near Markirch in the Vosges. The crystals are one to three lines long and in thin prisms. They occur in granular limestones along with a bluish green alumina-magnesian silicate which is homogenous and massive in texture, and without cleavage.

CALCITE [p. 435, 503, and I, II, III, IV, V].—The calcite from Sparta, New Jersey, associated with zincite, has been named Spartaite by Breithaupt. By measurement $R:R=104°\ 57\frac{1}{2}'$; G.=2·808—2·818. An analysis by Jenzsch is given in Suppl. II.—Breithaupt in Berg. u. Hutt. Zeit. xvii, 53.

CARMINE SPAR [p. 410].—F. Sandberger gives the following analysis (Pogg. ciii, 345) of carmine spar:

Arsenic acid ($\dot{A}s$) 49·11	$\dot{F}e$ 30·29	$\dot{P}b$ 24·55

whence the formula $\dot{P}b^3\dot{A}s+5\dot{F}e\dot{A}s$=Arsenic acid 48·5, sesquioxyd of iron 28·1, oxyd of lead 23·5. G.=4·105.

CASSITERITE [p. 118, and V].—Tin ore occurs at Xeres in Mexico.—C. Bergemann in N. Jahrb. 1857, p. 395.

CELESTINE [p. 368].—Fine crystals from Pschow in Upper Silesia have been described by Websky in the Zeits. G. Ges. ix, 303. The planes (arranged according to the zones in the direction of the brachydiagonal) are as follows: i-$\breve{1}$; i-2, I, i-$\breve{2}$; 4-$\breve{\frac{8}{3}}$; 2-$\breve{4}$, 2-$\breve{1}$; $\frac{5}{3}$-$\breve{\frac{5}{2}}$; $\frac{3}{2}$-$\breve{3}$; $\frac{4}{3}$-$\breve{4}$; $\frac{8}{7}$-$\breve{8}$; $\frac{24}{23}$-$\breve{24}$, (the five preceding planes forming an oblique zone between I and 1-i); $\frac{6}{5}$-$\breve{\frac{12}{5}}$; 1, 1-$\breve{2}$, 1-$\breve{3}$, 1-$\breve{6}$, 1-$\breve{16}$, 1-$\breve{1}$; $\frac{3}{2}$-$\breve{4}$, $\frac{3}{2}$-$\breve{6}$, $\frac{3}{2}$-$\breve{16}$, $\frac{3}{2}$-$\breve{1}$; $\frac{1}{2}$-$\breve{1}$; $\frac{1}{2}$-$\breve{\frac{1}{2}}$, $\frac{1}{4}$-$\breve{1}$, O.

Pseudomorphs of amorphous quartz after celestine are described by R. Blum and L. Carius, in Pogg., ciii, 628.

CHALYBITE [p. 444, and III, IV].—An iron and magnesia carbonate affording the ratio 1 : 2 between the $\dot{M}g\breve{C}$ and $\dot{F}e\breve{C}$, has been named by Breithaupt (Berg. u. hütt. Zeit. xvii, 54) *Sideroplesite*. He gives $R:R=107°\ 6'$; G. =3·616—3·660, Analysis of a specimen from Pöhl (of which G.=3·616) afforded Prof. Fritzsche (mean of two analyses), $\breve{C}$ 41·93, $\dot{F}e$ 45·06, $\dot{M}g$ 12·16; or

$$\dot{M}g\breve{C}\ 26{\cdot}58 \qquad \dot{F}e\breve{C}\ 73{\cdot}42 = 100 = \dot{M}g\breve{C}+2\dot{F}e\breve{C}.$$

Traversella in Piedmont and Böhmsdorf near Schleiz are mentioned as other localities. [Analyses 9, 10, page 445 of Min. are of the same compound.] Another related compound from Mitterberg in the Tyrol, afforded Dr. Khuen (mean of two analyses), $\breve{C}$ 39·83, $\dot{F}e$ 51·65, $\dot{M}n$ 0·81, $\dot{M}g$ 7·51; or

$$\dot{M}g\breve{C}\ 15{\cdot}33 \qquad \dot{F}e\breve{C}\ 84{\cdot}67 = \dot{M}g\breve{C}+4\dot{F}e\breve{C}.$$

CHONDRODITE [p. 186, and II].—Hessenberg has some notes on the crystals of humite in his Min. Not., p. 14 of the Fortsetzung. [He has overlooked the view of the crystallization of humite taken in the Mineralogy, p. 186 (and Jour. Sci., [2], xiv, 175)—a view that brings out better the isomorphism with chrysolite, and approximates the types closely to one another.] He mentions some new planes; a brachydome, making about 119° 46′ with the plane O; also the plane 4-$\breve{\frac{3}{2}}$. He also mentions the occurrence of the planes 12-$\breve{\frac{3}{2}}$ and $\frac{12}{5}$-$\breve{\frac{3}{2}}$. Assuming that the crystals are monoclinic, the latter two are +, and the other —.

CHRYSOLITE [p. 184].—A crystal of Forsterite, from Vesuvius, is described and figured by Hessenberg (Min. Not., p. 21). It has the planes O, i-$\breve{1}$, i-$\breve{\frac{3}{2}}$, I, i-$\breve{\frac{2}{5}}$, 1-$\breve{1}$, 1-$\breve{1}$, 1-$\breve{2}$, 1.

CLAUSTHALITE [p. 42].—Clausthalite occurs at the mines of Rio Tinto near Seville, in Spain. *Breithaupt* in Berg. u. hütt. Zeit., xvii, 98.

CLINTONITE [p. 297].—Pseudomorphs of Brandisite after pyroxene (fassaite) have been described by A. Müller (Verh. Nat. Ges. Basel, 4th Heft, 1857, p. 569). They are from Monzoniberg in the Tyrol. Some crystals of the fassaite at that locality are untouched, while others have been more or less perfectly changed.

COAL.—On the assaying of mineral coals by the blowpipe, by E. J. Chapman.—Canadian Journal, Toronto, May, 1858.

COLUMBITE [p. 353, and II, IV, V].—Breithaupt has named (Berg. u. hütt. Zeit. xvii, 61) columbite crystals from the Greenland cryolite vein, *Greenlandite*, finding $I:I=141°\ 56'$, $1\text{-}\breve{\imath}:i\text{-}\breve{\imath}$ (over P) $=136°\ 34'$, $3\text{-}\breve{\imath}:3\text{-}\breve{\imath}$ (over P) $=79°\ 51'$. G.=5·432 –5·450. [Breithaupt has erred in making the brachydiagonal of columbite his vertical axis. By changing the position so as to make it conform to the usual position in columbite, then his brachydiagonal becomes the vertical axis, and his vertical the brachydiagonal, and the angles stand thus:

	Middletown Columbite, D.	Greenland Columbite, Descloizeaux.	Greenlandite Breithaupt.	Breithaupt's lettering.
$I:I$	= 100° 40′	100° (from $I:i\text{-}\breve{\imath}$)	100° 9′	= $o:o$ over b
$i\text{-}\breve{3}:i\text{-}\breve{3}$	= 136° 12′	137° (from $i\text{-}\breve{3}:i\text{-}\breve{\imath}$)	136° 34′	= $n:n$ over P
$\frac{1}{3}\text{-}\breve{\imath}:\frac{1}{3}\text{-}\breve{\imath}$	= 141° 8′	141°	141° 56′	= $M:M$

It is unnecessary to go further, as these angles determine the values of all the others. An excellent paper on the Greenland columbite by Descloizeaux is referred to in Suppl. IV.—D.]

Breithaupt remarks in the course of his paper that the Tantalite group has an angle of 121½° to 123½° for the fundamental prism and thus differs widely from the Columbite group. [It is shown in the Mineralogy, that the relation between the two is by simple ratios, and that they may be regarded as closely approaching in the angle of the fundamental prism.—D.]

COPPER [p. 115 and IV].—A native copper pseudomorph after aragonite, and probably from Lake Superior, has been described by E. Sochting (Pogg. civ, 332).

COPPER NICKEL [p. 52].—A copper nickel from the Sangerhäuser Revier, afforded Grunow (Zeitsch. D. geol. Ges., ix, 40):

As 54·89	S 1·35	Ni 43·21	Fe 0·54

Another ore afforded, As 48·7, Ni 48·4, S 2·8.

DATHOLITE [p. 334, and I, II, III, IV].—H. Dauber (Pogg. ciii, 116) has made new measurement of the crystals from Andreasberg and Toggiana. The form he has determined to be monoclinic, with the inclination of the vertical axis 90° 8′ 40″. $i\text{-}\breve{2}:i\text{-}\breve{2}=76°\ 38'\ 33''$ at 15° C., 76° 39′ 50″ at 70° C.; in another trial 76° 40′ 16″ at 18° C., 76° 41′ 47″ at 84° C. $O:2\text{-}i=147°\ 42'\ 45'$ at 11° C., 147° 42′ 43″ at 80° C.; in another, 147° 36′ 11″ at 11° C., 147° 36′ 13″ at 71° C. $O:i\text{-}i=90°\ 9'\ 46''$ at 18° C., 90° 8′ 42″ at 80° C.; O on the opposite $i\text{-}i=89°\ 53°\ 55'$ at 22° C., 89° 54° 8′ at 52° C. The orthodiagonal was more affected by the heat than the clinodiagonal. The planes observed were the following (arranged in vertical zones) O, $\frac{1}{3}\text{-}i$, $2\text{-}i$, $4\text{-}i$, $i\text{-}i$, $-2\text{-}i$; $-5\text{-}\frac{5}{2}$; $i\text{-}2$, $-4\text{-}2$; $i\text{-}\frac{3}{2}$, $-3\frac{3}{2}$; $\frac{1}{3}$, I, -4, -2; $\frac{6}{5}\text{-}\breve{3}$; $4\text{-}\grave{\frac{4}{3}}$; $2\text{-}\grave{2}$, $4\text{-}\grave{2}$, $i\text{-}\grave{2}$, $-3\text{-}\grave{2}$; $2\text{-}\grave{4}$, $4\text{-}\grave{4}$; $2\text{-}i$, $3\text{-}i$, $4\text{-}i$, $i\text{-}i$ (see Supplement III for tables of comparison.)

ENARGITE [p. 87, 506, and IV].—The occurrence of enargite at the mines of Santa Anna in New Granada has been announced by W. J. Taylor (Proc. Acad. Sci. Philad., 1857, p. 168). It is a brittle metallic mineral occurring in small cavities in quartz. The color and streak are grayish black, and the powder has a metallic lustre. BB. decrepitates; on charcoal, the odor of arsenic and a slight incrustation of antimony. An analysis of ·7082 gram afforded:

S 34·50	As 16·31	Sb 1·29	Cu 46·62	Fe 0·27 = 98·99

There was a slight loss in the arsenic. The atomic proportions are Cu : As + Sb : S = 1·47 : 0·23 : 2·16; whence is deduced the constitution $6CuS, AsS^3$.

EPIDOTE [p. 206, and II, III, IV, V].—Hessenberg has described different crystals of epidote (Min. Notizen, p. 23 and Fortsetzung). In the following descriptions the brackets include planes not before observed.

1. Zermatt, O, $i\text{-}i$, $1\text{-}i$, $-1\text{-}i$, $-2\text{-}i$, $-3\text{-}i$, $i\text{-}2$, $i\text{-}\breve{\imath}$, $i\text{-}4$, 1, –1, –3·3, [$-\frac{1}{3}$, $5\text{-}\breve{5}$, $2\text{-}\frac{4}{3}$].
2. St. Gothard, O, $i\text{-}i$, $-1\text{-}i$, $-3\text{-}i$, $i\text{-}2$, 1, $\frac{1}{3}\text{-}\breve{\imath}$, [$-7\text{-}i$, $-\frac{1}{7}\text{-}i$, $-7\text{-}7$].
3. Bourg d'Oisans, $i\text{-}i$, $1\text{-}i$, $-1\text{-}i$, $3\text{-}i$, $i\text{-}2$, $i\text{-}\breve{\imath}$, $\frac{1}{3}\text{-}\breve{\imath}$, 1·2.
4. Ala, O, $i\text{-}i$, $1\text{-}i$, $-1\text{-}i$, $-3\text{-}i$, $i\text{-}2$, $i\text{-}4$, 1, –1, –3·3, [$-\frac{1}{3}$, $-5\text{-}\frac{5}{2}$, $2\text{-}\frac{4}{3}$, $3\text{-}\frac{3}{2}$, $2\text{-}\grave{2}$].

[The known planes of Epidote enumerated according to the vertical zones, corresponding with the tables in the Mineralogy, are as follows: O; $\frac{1}{4}$-i, $\frac{1}{2}$-i, 1-i, 2-i, 3-i, i-i, -7-i, -3-i, -2-i, -1-i, $-\frac{1}{2}$-i; 2-$\frac{4}{3}$; 3-$\frac{3}{2}$; 1-2, 2-2, i-2, -1-2; -5-$\frac{5}{3}$; 3-3, -3-3; i-4; -7-7; $\frac{1}{2}$, 1, I, -1, $-\frac{1}{2}$; 1-$\breve{2}$, 2-$\breve{2}$; 5-$\breve{5}$; $\frac{1}{4}$-$\breve{i}$, 1-$\breve{i}$, i-$\breve{i}$. It may be repeated here that in this lettering, i stands for ∞ or infinity, and the $\breve{}$ indicates that the number refers to the clinodiagonal. Otherwise the symbols are those of Naumann, except that the useless P is dropped.—D.]

Epistilbite [p. 330, and IV].—H. How has detected this species in Nova Scotia in trap at Margaretville, seven miles east of Port George (this volume, p. 33). It accompanies fine stilbite, and is in small reddish rhombic crystals nearly or quite opaque, and sometimes the only lining in shallow cavities. Analysis afforded Mr. How:

	$\ddot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{K}$	$\dot{N}a$	$\dot{H}$	
1.	58·57	15·34	1·58	7·00	0·99	0·99	15·42	= 99·89
1.	58·35	16·73	——	7·87	——	2·10	14·93	= 100

The second analysis is of a Nova Scotia specimen of uncertain locality. The formula is $(\frac{1}{4}\dot{N}a+\frac{1}{4}\dot{C}a)\ddot{S}i+\dot{A}l\ddot{S}i^{3}+5\dot{H}$.

Erubescite [p. 38, and III].—An argentiferous erubescite from the mine of Ramos in Mexico afforded C. Bergemann (L. and Br. N. Jahrb., 1857, p. 394), Sulphur 23·46, copper 62·17, iron 11·79, silver 2·58. G.=5—5·476.

Euclase [p. 267, and II].—The crystals of euclase from the Urals, announced in Suppl. V, have, according to Kokscharov, the following planes (Pogg., ciii, 348, taking the same planes for the fundamental form as in Schabus's paper, -3-3 in Min.), $\frac{1}{4}$-i; i-9; 1, -1, I; 3-$\breve{\frac{3}{2}}$; 2-$\breve{2}$, i-$\breve{2}$, -2-$\breve{2}$; 3-$\breve{3}$; 4-$\breve{4}$; 1-$\breve{i}$, 2-$\breve{i}$, 3-$\breve{i}$, 4-$\breve{i}$, 6-$\breve{i}$.

Faroelite [p. 328, and IV, V].—H. How has detected faroelite among the trap minerals of the Bay of Fundy, on the shore of Annapolis county, near a small fishing village called Fort George, a few miles to the west of Blomidon (this volume, p. 31). It has hardness 4·5, and gelatinizes perfectly with muriatic acid before and after ignition. Composition according to Mr. How (mean of three analyses):

$\ddot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{N}a$	$\dot{H}$
41·26	29·60	11·71	5·29	12·73

giving nearly the oxygen ratio for $\dot{R}$, $\ddot{R}$, $\ddot{S}i$, $\dot{H}$, $1:3:5:\frac{8}{3}$, whence Heddle's formula $3(\frac{1}{4}\dot{N}a+\frac{3}{4}\dot{C}a)\ddot{S}i+\dot{A}l^{6}\ddot{S}i^{2}+8\dot{H}$.

Garnet [p. 190, and I, II, III, IV, V].—A crystal from granular limestone at Auerbach is figured by Hessenberg (Min. Not., p. 22), which has the new plane i-$\frac{3}{2}$.

Gieseckite [p. 233, and I].—G. J. Brush has described (this vol., p. 64) fine large hexagonal crystals of what appears to be Gieseckite (pseudomorphous nepheline) from Diana, Lewis Co., N. Y. They occur in granular limestone with pyroxene and magnetic pyrites. Some crystals have very distinct prismatic cleavage; others have none, the texture being waxy. The angles also vary much. These diversities, according to Prof. Brush, show that the crystals are pseudomorphs; and the *form* that they were originally nepheline. The hexagonal prisms have the basal edges replaced by a single plane. $O:1$ (this plane) 133° to 137°, but mostly between 135° and 136°; in some cases between 131° and 139°, with the crystals slightly oblique. H.=3—3·5. G.=2·736—2·75. Color pea-green to leek-green. Lustre mostly feeble, and often waxy. BB. becomes opaque and fuses to a white enamel. Analyses were made of the cleavable and uncleavable kinds, but no essential difference of composition was found. Mean of three analyses by Prof. Brush:

$\ddot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$	$\dot{C}a\ddot{C}$
45·67	31·51	0·27	0·77	2·20	3·48	0·88	8·21	6·97	0·32

giving the oxygen ratio for $\dot{R}:\ddot{R}:\ddot{S}i:\dot{H}=1:3·70:5·97:1·55$, or $2:7:12:3$, and the formula $(\frac{2}{3}\dot{R}^{3}+\frac{7}{9}\ddot{R})^{3}\ddot{S}i^{4}+3\dot{H}$, or in a more general form $(\dot{R}^{3},\ddot{R})^{3}\ddot{S}i^{4}+3\dot{H}$; and if the water be basic, it becomes $(\dot{R}^{3},\ddot{R},\dot{H}^{2})\ddot{S}i$. This last is probably the correct view of the compound, if it be, as supposed, a result of the alteration and attendant hydration of an anhydrous mineral.

Prof. Brush compares the composition with that of liebenerite and the potash pinites in a table, and suggests that some of the latter may have the same origin. He also points out a close approximation chemically to agalmatolite (in part), dysyntribite and parophite. All are probably results of alteration or metamorphism, but perhaps derived from different original ingredients, just as kaolin may come from different minerals.

GADOLINITE [p. 211, and IV].—According to H. Rose (Pogg., ciii, 314), the specific gravity of gadolinite, after thirty trials, is 4·097 to 4·226, and after heating 4·287 to 4·456; the loss by ignition 0·38 to 0·43 per cent.

GAS.—Gases of Volcanos, Deville, Ann. Ch. Phys., [3], lii, Jan. 1858, p. 5.

GREENLANDITE.—See *Columbite.*

GOLD [p. 7, and I, II, V].—New deposits have been found on Frazer's river, north of Oregon, and others near Pike's Peak on the River Fontaine-qui-bouit, in Western Kansas.

GRAMENITE, *Krantz.*—Gramenite comes, according to C. Bergemann (L. and Bronn's N. Jahrb., 1857, 395), from Menzenberg in the Siebengebirge. It resembles in its fine grass-green color pinguite and nontronite and is essentially a silicate of sesquioxyd of iron. In thin lamellæ aggregated together; H.=1; G.=1·87; lustre greasy, as in pinguite; no alumina smell when moistened. BB. acts like pinguite, and in a tube becomes dull brown, giving off much water; becomes magnetic. Decomposed perfectly in acids, but with difficulty. Composition, according to Bergemann:

$\dot{S}i$	$\dot{F}e$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{K}$	$\dot{H}$
38·39	25·46	6·87	2·80	0·67	0·75	0·56	1·14	23·36=100.

The oxygen of the silica is about twice that of the bases. The mineral has proceeded from the decomposition of some feldspathic rock and by the substitution of sesquioxyd of iron for alumina.

HETEROMORPHITE [p. 76].—Found in cob-web forms at Chonta, Peru. W. J. Taylor, this vol., p. 134.

HORNBLENDE and PYROXENE [p. 170, and I, II, III, IV, V].—The relations of pyroxene and hornblende are reviewed by Rammelsberg in Pogg., ciii, 284. The form and composition of the different varieties of the species are considered by the author and important conclusions deduced.

Wollastonite, *Babingtonite*, and *Rhodonite* (Paisbergite) are shown to be isomorphous with pyroxene. [The particulars are not here cited, as Rammelsberg has followed (although he does not say so) what has already been published by the writer. See for *Wollastonite* the Mineralogy, p. 156, and this Jour. Sci., xv, 449 (1853), and for *Babingtonite* and *Rhodonite*, Supplements II and III. Dauber showed the relation of these two species in angles, but did not recognise their common relations to pyroxene. See also on the relations of spodumene to pyroxene in crystallization, by the writer, in this Jour. Sci., vol. x, p. 120 (1850), where also the relations *in composition* are shown, in the manner now adopted by Rammelsberg; and on the same crystallographic relations by Rammelsberg in 1852, Pogg., lxxxv, 544.

Edenite of Breithaupt is a whitish aluminous hornblende from Edenville, N. Y.; it has $I : I = 124° 22'$; G.=3·059, R. (2·90 Br.)

Ægirine from Brevig is a pyroxene with the angle $I : I = 86° 52'$. The name is also improperly applied to a black hornblende from the same region. *Acmite* is well known to have the form of pyroxene; and *Pyroxene* a simple relation in form to *Hornblende* generally [see Min., p. 166].

He takes up next the relations in composition, dividing the group into 1, silicates of protoxyds; 2, silicates of protoxyds and sesquioxyd of iron; 3, silicates of protoxyds and sesquioxyd of iron with alumina, or aluminous augites and hornblendes; 4, silicates of protoxyds with alumina and no sesquioxyd of iron, as in spodumene. The aluminous species *all contain alkalies.*

I. *Bisilicates of protoxyds.*—The light colored pyroxenes (diopside, malacolite, &c.) have in general the composition $\dot{C}a^3\ddot{S}i^2 + \dot{M}g^3\ddot{S}i^2$. White pyroxene (*malaco-*

lite) from Retzbanya afforded Rammelsberg, $\breve{S}i$ 56·03, $\dot{C}a$ 25·05, $\dot{M}g$ 17·36, $\dot{F}e$ 1·38 =99·82; giving the oxygen ratio for the bases and silica 14·40 : 29·09=1 : 2·02; and that between the lime and the other bases 7·16 : 7·24.

Tremolite and Actinolite afforded on analysis the following results: 1, colorless from St. Gothard, G.=2·930; 2, yellowish white columnar from Sweden, G.=2·940; 3, white from Gouverneur, N. Y., G.=3·00; 4, greenish white columnar from the Island Maneetsok, Greenland, G.=3·004; 5, green actinolite from Greiner in the Zillerthal, in talc, G.=3·067; 6, grayish green actinolite from Arendal, in large crystals, G.=3·026.

	$\breve{S}i$	$\dot{C}a$	$\dot{M}g$	$\dot{F}e$	$\dot{A}l$	ign.
1*a*.	57·72	13·95	27·45	*tr.*	——	0·33= 99·45
1*b*.	58·38	13·86	26·90	*tr.*	——	0·34= 99·48
1*c*.	58·25	14·03	[27·33]	*tr.*	——	0·39=100·
2.	58·87	11·00	28·19	*tr.*	1·77	0·18=100·01
3.	57·40	13·89	25·69	1·36	0·38	0·40= 99·12
4.	54·71	15·06	23·92	2·41	——	3·33= 99·43
4. (ign. excl.)	56·60	15·58	24·74	2·48	——	——= 99·40
5.	55·50	13·46	22·56	6·25	——	1·29= 99·06
6.	56·77	13·56	21·48	5·88	0·97	2·20=100·86

The oxygen ratio for the bases and silica in 1, 1 : 2·03—2·09; in 2, 1 : 2·00; in 3, 1 : 2·02; in 4, 1 : 1·97; in 5, 1 : 2·02; in 6, 1 : 2·07. The ratio is *the same therefore, as in diopside*, 1 : 2; and the only difference is that *in the hornblendic mineral the lime is to the other bases as* 1 : 3, *instead of* 1 : 1, or the formula is $\dot{C}a^3\breve{S}i^2+3\dot{M}g^3\breve{S}i^2$ in place of $\dot{C}a^3\breve{S}i^2+\dot{M}g\breve{S}i^2$.

Anthophyllite is also a similar bisilicate, having the formula $\dot{F}e^3\breve{S}i^2+3\dot{M}g^3\breve{S}i^2$.

II. *Bisilicates of protoxyds and sesquioxyd of iron.—Acmite* afforded Rammelsberg on analysis (mean of results):

$\breve{S}i$ 51·66, $\dot{T}i$ 1·11, $\ddot{F}e$ 28·28, $\dot{F}e$ 5·23, $\dot{M}n$ 0·69, $\dot{N}a$ 12·46, $\dot{K}$ 0·43, ign. 0·39=100·25. It affords the oxygen ratio, for $\dot{R}$, $\ddot{R}$, $\breve{S}i$, 1 : 1·85 : 5·85; or for all the bases and silica 2·85 : 5·86=1 : 2·06. Whence the ratio is the pyroxene ratio instead of that of hornblende, and the formula is $(\dot{N}a,\dot{F}e)^3\breve{S}i^2+2\ddot{F}e\breve{S}i^2$, in which $\dot{F}e : \dot{N}a=1 : 3$. G.= 3·530.

Ægirine afforded

$\breve{S}i$	$\dot{A}l$	$\ddot{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$
50·25	1·22	22·07	8·80	1·40	5·97	1·28	9·29	0·94=100·72

whence the oxygen ratio for $\dot{R}$, $\ddot{F}e$, $\breve{S}i$=1·04 : 1 : 4·03, and the formula $\dot{R}^2\breve{S}i^2+\ddot{F}e\breve{S}i^2$, in which $\dot{R}$= equal parts of each $\dot{F}e$, $\dot{C}a$ and $\dot{N}a$.

Babingtonite afforded (mean):

$\breve{S}i$	$\ddot{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$, $\dot{K}$	ign.
51·22	11·00	10·26	7·91	19·32	0·77	*trace.*	0·44=100·92

whence the oxygen ratio $\dot{R} : \ddot{R} : \breve{S}i$=9·89 : 3·30 : 26·59, and the formula $3\dot{R}^6\breve{S}i^2+\ddot{F}e\breve{S}i^2$, in which $\dot{F}e : \dot{M}n : \dot{C}a$=4 : 3 : 10.

Arfvedsonite affords the formula $2\dot{R}^3\breve{S}i^2+3\ddot{F}e\breve{S}i^2$. Rammelsberg obtained (mean):

$\breve{S}i$	$\dot{A}l$	$\ddot{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	ign.
51·22	*trace.*	33·75	7·80	1·12	2·08	0·90	10·58	0·68	0·16=98·29

in which the oxygen ratio for the bases and silica is 1 : 1·92; and of $\dot{R} : \ddot{R}$=1 : 1·4. Ægirine, acmite, babingtonite and arfvedsonite consist of $\dot{R}^2\breve{S}i^2$ and $\ddot{F}e\breve{S}i^2$, in the different ratios, respectively, 1 : 1, 1 : 2, 3 : 1, 2 : 3.

It follows from these results, that the silicates of protoxyds and silicates of sesquioxyds are isomorphous, [a principle recognized and illustrated throughout the Mineralogy through these and other species.]

III. *Aluminous varieties of pyroxene and hornblende.*

Analyses of aluminous pyroxene by Rammelsberg. 1. Augite from Monte Rossi, Etna; small black crystals; powder gray; G.=3·376. 2–4. Augite from Lake Laach, in crystals; powder gray; G.=3·348.

	Si	Al	Fe	Fe	Mn	Ca	Mg	ign.
1.	47·38	5·52	3·85	7·89	0·10	19·10	15·26	0·43 = 99·53
2.	47·52	8·13	5·83	7·77	0·40	18·25	12·76	—— = 100·66
3.	51·12	3·38	0·95	5·45	2·63	23·54	12·82	—— = 99·89
4.	50·03	3·72	2·36	6·65	0·15	22·85	13·48	—— = 99·24

Aluminous hornblendes. Analyses by Rammelsberg (mean of results for each):

1. Pale-colored hornblende from Edenville; G.=3·059.
2. Pargasite from Pargas; G.=3·104.
3. Bluish gray hornblende from Monroe, Orange Co., N. Y.; G.=3·123.
4. Foliated, from Saualpe, Carinthia: G.=3·102; *I*: *I*=124° 8′—12′.
5. Black, ferruginous, from near Bosgolowsk, Urals; G.=3·214.
6. Ibid., Pargas; G.=3·215.
7. Ibid., Arendal; G.=3·276.
8. Ibid., Philipstadt, Wermland; G.=3·278; *I*: *I*=124° 30′.
9. Ibid., Brevig; G.=3·428; *I*: *I*=3·428.
10. Ibid., Fredericksvärn; G.=3·287; *I*: *I*=124° 7′.
11. Ibid., Vesuvius; G.=3·282.
12. Ibid., Härtlingen; G.=3·270.
13. Ibid., Cernosin, in Bohemia; G.=3·225.
14. Ibid., Honnef, in Siebengebirge; G.=3·277.
15. Ibid., Stenzelberg, ib.; G.=3·266.

	Fl	Si	Al	Fe	Fe	Mn	Ca	Mg	Na	K	ign.
1.	——	51·67	5·75	2·86	——	——	12·42	23·37	0·75	0·84	0·46 = 98·12
2.	2·76	46·12	7·56	——	2·27	*trace.*	13·70	21·22	2·48	1·29	1·10 = 98·50
3.	——	45·93	12·37	——	4·55	0·34	12·22	21·12	2·24	0·98	0·59 = 100·34
4.	0·21	49·33	12·72	1·72	4·63	——	9·91	17·44	2·25	0·63	0·29 = 99·13
5.	0·25	44·24	8·85	5·13	11·80	——	10·82	13·46	2·08	0·24	0·39 = 98·27*
6.	1·70	41·26	11·92	4·83	9·92	*tr.*	11·95	13·49	1·44	2·70	0·52 = 99·73†
7.	——	43·18	10·01	6·97	14·48	0·29	11·20	9·48	2·16	1·30	0·37 = 99·44
8.	——	37·84	12·05	4·37	12·38	0·68	14·01	12·16	0·75	2·63	0·80 = 97·67
9.	Ti 1·01	42·27	6·31	6·62	21·72	1·13	9·68	3·62	3·14	2·65	0·48 = 98·63
10*a*.	" 0·80	40·00	8·00	10·10	11·04	1·03	10·26	11·51	2·72	2·53	0·60 = 98·59
10*b*.	" 1·07	40·00	7·37	10·45	13·38	1·85	11·28	7·51	[5·25]		0·54 = 98·70
11.	——	39·92	14·10	6·00	11·03	0·30	12·62	10·72	0·55	3·37	0·37 = 98·78
12.	" 1·01	42·52	11·00	8·30	9·12	——	12·25	13·45	1·71	1·92	—— = 101·28
13.	" 0·80	40·65	14·31	5·81	7·18	——	12·55	14·06	1·64	1·54	0·26 = 99·10
14.	" 1·53	41·01	13·04	5·38	10·75	——	9·31	13·48	1·26	1·79	0·79 = 98·34
15.	" 0·19	39·62	14·92	10·28	7·67	0·24	12·65	11·32	1·12	2·18	0·48 = 99·67

* Ti 1·01 included. † Ti *trace.*

Rammelsberg compares the oxygen ratio of the bases, and silica; of the protoxyds, sesquioxyds, and silica; of the protoxyds on the one side with the sesquioxyds and silica on the other; of the protoxyds and sesquioxyd of iron on the one side with the alumina and silica on the other; and concludes that the last (which was first proposed by Bonsdorff) is the right method.

This method, applied to the above analyses of aluminous pyroxene and hornblende, gives for the oxygen of the silica and alumina, that of the other bases being 1, the following numbers: for the *pyroxenes*, 1·78, 2·06, 2·02, 2·06; *hornblende*, 1, 2·09; 2, 2·00; 3, 2·15; 4, 2·62; 5, 2·02; 6, 2·03; 7, 2·06; 8, 1·85; 9, 2·00; 10*a*, 1·70; 10*b*, 1·75; 11, 2·20; 12, 1·93; 13, 2·11; 14, 2·16; 15, 1·99. Hence, *the hornblendes are bisilicates* (or have the ratio 1 : 2) *like all pyroxenes:* and the aluminous species differ in having part of the silica replaced by alumina. In some varieties it is still possible that part of the alumina is basic.

Rammelsberg closes by making some explanations respecting the exceptional cases in the list, and by a recapitulation of his conclusions. The conclusion which is especially new is that the hornblendes have the same oxygen ratio as pyroxene, viz. 1 : 2, between the bases and silica, and hence all are alike *bisilicates.* [The general formula $(\dot{R}^3, \dot{\dot{R}})\ddot{S}i^2$ includes the whole, as well also as beryl.—D.]

Hureaulite [p. 407].—Crystals of Hureaulite from the quarry of Vilate near Chanteloube, have afforded Descloizeaux the following results (Ann. der Ch. et. de Phys., [3], liii, 293):

Form monoclinic; $I : I = 61°$, $O : I = 90° 17'$, $O : i\text{-}i = C = 90° 33'$. Optically biaxial; the two axes very divergent, their plane parallel to the orthodiagonal; the bisectrix positive, and inclined 74° 27′ towards a normal to the base. Color of different varieties, violet, brownish-orange, rose-red; lustre bright; translucent. The crystals approach in habit those of chromate of lead, although quite different in angle. $O : 3\text{-}i = 122° 53'$ $O : \frac{1}{3}\text{-}i = 174° 2'$, $O : 1\text{-}i = 138° 22'$. Various other angles are given in the paper. The violet, yellow and rose varieties differ in their modifications. Composition according to Damour:

	$\dot{P}$	$\dot{M}n$	$\dot{F}e$	$\dot{H}$	Mixed sand.
1. Yellow variety,	37·96	41·15	8·10	12·35	0·35 = 99·91
2. " "	38·20	42·04	6·75	12·00	0·50 = 99·49
3. Rose "	37·83	41·80	8·73	11·60	0·30 = 100·26

whence the oxygen ratio for $\dot{H}$, $\dot{R}$, $\dot{P}$, 1 : 1 : 2, and the formula $(\dot{M}n, \dot{F}e)^6\dot{P}^2 + 5\dot{H}$.

Ialpaite.—See *Silver-Glance*.

Iron Ores.—The iron ore of the Iron Mountain, Missouri, afforded E. Harrison (Proc. Bost. Soc. Nat. Hist., 1857, p. 295) Iron 68·95, oxygen 27·00, sand, etc., 3·07, manganese trace = 99·02, the composition of hematite, $\dot{F}e$. An analysis is also given of the ore of Pilot Knob, but the specimen was too impure to afford results of mineralogical interest.

KOKSCHAROVITE. *N. Nordenskiold.*—According to Nordenskiold (Bull. Nat. Moscow, 1857, p. 223), this mineral occurs in crystalline masses, cleavable according to two directions inclined to one another, 124°—124° 5′. H. = 5—5·5; colorless to brown; high lustre, approaching adamantine when colorless. No analysis is given. BB. only a trace of water; fuses easily to a white subtransparent glass; also a clear glass with borax; gives the reaction for silica; a blue color with cobalt-solution. No action with acids. [The angle is that of tremolite or hornblende.]

Lanthanite [p. 436 and I, III, IV].—Lanthanite is found, according to W. P. Blake, (this vol. p. 245) with allanite at the Sanford Iron Ore Bed, Moriah, Essex county, New York. It is in delicate scales or a thin scaly crust in fissures in the ore, and on allanite crystals. The scales or plates have a cleavage, like mica, and some are quite brilliant; lustre pearly; color varying from white to a delicate pink or rose-tint.

Lapis Lazuli [p. 229].—Lapis Lazuli and its associated minerals at Bucharei, Siberia, are described by N. Nordenskiold. in Bull. Soc. Imp. Nat. Moscow, 1857, No. 1, p. 213. It occurs in regular dodecahedrons having also the faces of the cube, H.=5. Color blue, violet-blue, red, and green. The specimen analyzed by Varrentrapp was probably from Bucharei. The crystals occur in limestone with small crystals of pyrites, apatite, glaucolite and kokscharovite.

Laumontite [p. 307, and IV, V].—According to H. How (this Journal, p. 34) laumontite is abundant at Port George, Nova Scotia; the veins are sometimes three inches thick, and at Margaretville it is colored green by copper.

LECONTITE, *W. J. Taylor.*—The Lecontite of Taylor (Proc. Acad. Nat. Sci. Philad., and this vol., p. 273) is a sulphate of ammonia and soda, from a cave (cave of Las Piedras) frequented by bats in the vicinity of Comayagua, Honduras, where it was probably formed from their excrements. Crystallization trimetric; crystals partly narrow prisms an inch long, and partly very short and broad. Faces O, I, $i\text{-}\breve{2}$, $\frac{1}{2}\text{-}\breve{1}$, $i\text{-}\breve{1}$. $I : I = 103° 12'$; $i\text{-}\breve{2} : i\text{-}\breve{2} = 115°$, $\frac{1}{2}\text{-}\breve{1} : \frac{1}{2}\text{-}\breve{1} = 127° 30'$ to 128°; 128° gives for $O : 1\text{-}\breve{1} = 117° 7'$. H.=2—2·5. Clear and colorless when free from the exterior organic matter; taste saline and rather bitter; permanent in the air. Composition, according to Taylor:

$\dot{S}$	NH^4O	$\dot{N}a$	$\dot{K}$	$\dot{H}$	$\dot{P}$	Org. & Inorg. residue.
44·97	12·94	17·56	2·67	19·45	*trace*	2·41

giving the oxygen ratio for the bases, acid and water, 8·93 : 26·94 : 17·28 = 1 : 3 : 2; and the formula $(\dot{N}a, NH^4O)\ \dot{S} + 2\dot{H}$, in which the ammonia is to the other bases nearly as 4 to 5.

LEUCITE [p. 231, and III, V].—The crystals from Kaiserstuhl, of which an analysis by C. Stamm, is given in Suppl. IV (but incorrectly attributed to Mr. Weltzien) under *Analcime*, are regarded by Rose as altered leucite (Pogg. ciii, 521); and he observes in connection, that an altered seemingly kaolinized leucite from Rocca Monfina analyzed by Rammelsberg (see Suppl. V, under Leucite) is of similar composition. The oxygen ratio for $\dot{R}$, $\dot{R}$, $\ddot{S}i$, $\dot{H}$ in Leucite is 1 : 3 : 8 : 0; in Analcime 1 : 3 : 8 : 2; in the Kaiserstuhl crystals 1·03 : 3 : 7·69 : 2·18; in the Rocca Monfina 0·83 : 3 : 7·10 : 2·11; and another from the same locality 0·68 : 3 : 6·77 : 1·96.

MAGNETITE [p. 105. and II, IV].—Octahedral crystals (having the edges truncated) feebly magnetic and giving a red powder, and consequently possessing the characteristics of hematite, occur, according to E. J. Chapman, (Canadian Journal, No. 16), in a feldspar boulder on Bass Lake, Canada West. Prof. Chapman suggests the question whether the crystals are pseudomorphous after magnetite, or octahedral sesquioxyd of iron, and favors the former conclusion.

MANGANBLENDE [p. 41].—Occurs with tetrahedrite at the mine Preciosa in the district of Puebla in Mexico. C. Bergmann, in L. & Br. Neues Jahrb., 1857, p. 394, where an analysis is given.

MESOLITE [p. 328, and IV].—According to H. How (this vol., p. 32) occurs in Nova Scotia with faroelite (which see), sometimes in large masses; one mass was several inches through, and was said originally to have been as large as a man's head. Also found in the North Mountains of Annapolis. A specimen was impressed with a large crystal of analcime, and had upon it a little stilbite, showing that the analcime was first formed. Structure usually fine fibrous, radiated, and somewhat plumose; sometimes coarser columnar and nearly transparent. Composition, according to H. How:

	$\ddot{S}i$	$\ddot{A}l$	$\dot{C}a$	$\dot{N}a$	$\dot{H}$	
1. Dried at 212°,	46·84	25·92	9·63	5·21	12·11 =	99·74
2. " "	46·48	27·04	9·63	[4·45]	12·40 =	100.00
3. Dried over HSO_4,	46·71	26·68	9·55	5·68	11·42 =	100·04

whence the formula $3\,(\frac{1}{3}\,\dot{N}a + \frac{2}{3}\,\dot{C}a)\,\ddot{S}i + 3\ddot{A}l\,\ddot{S}i + 8\dot{H}$.

MIASCITE.—A mineral under this name, supposed to be the miascite in part of Dufrenoy, has been analyzed by A. Gages (Phil. Mag. [4], xv, 180). It is from Miask in Siberia. It consists of fibres mixed with dolomite. The fibres afforded on analysis: Silica 68·181, magnesia 28·909, alumina 2·181, iron *trace* = 99·271. The author supposes that the fibres have been formed from tremolite by alteration, and remarks that the removal of the lime of tremolite leads to the same composition. [There is an approximation in constitution to talc or steatite.—D.].

MICROCLINE [Under Orthoclase, p. 245].—Breithaupt gives the following angles for a green feldspar crystal from Kangerdluarsuk in Greenland, associated with sodalite and Eudialyte, (Berg. u. hütt. Zeit., xvii, 11): $O : i\text{-}\bar{\imath} = 90°\ 22'$ and $89°\ 38'$, and therefore *triclinic*. $O : I' = 113°\ 10'$, $O : I = 112°\ 9'$, $O : 1\text{-}\bar{\imath} = 129°\ 34'$, $i\text{-}\bar{\imath} : I' = 119°\ 13'$, $I : I' = 119°\ 4'$, $I : i\text{-}\bar{\imath} = 121°\ 43'$. The feldspar contains nearly as much soda as potash. Composition according to Mr. Utendörfer (Ibid, p. 12),

$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$
66·9	17·8	0·5	0·6	*trace*	8·3	6·5

specific gravity 2·582—2·599. The analyses 15, 16 in Min. p. 244 of green and blue feldspar, by Gmelin, are referred to microcline by Breithaupt. The Norwegian microcline is associated with sodalite and eukolite in zircon-syenite. Utendörfer found it to contain, $\ddot{S}i$ 68·16, $\ddot{A}l$ 20·50, $\dot{K}$ 6·62, $\dot{N}a$ 4·72 (Ibid, p. 51).

MOLYBDINE [p. 144].—According to Breithaupt (Berg. u. hütt. Zeit., xvii, 125), molybdine ($\ddot{M}o$) from Altenberg in Saxony crystallizes in trimetric prisms, having $I : \bar{I} = 136°\ 48'$; and it is therefore isomorphous with valentinite ($\ddot{S}b$). Breithaupt also remarks on the approximation in angle between romeine and scheelite, [a point brought out in the Min. i, 197].

MUSCOVITE [p. 221, 508, and under Mica in Suppl.].—The muscovite of Vesuvius is figured by Hessenberg (Min. Notizen, p, 12), presenting the planes *O*, $\frac{4}{3}$-$\breve{\imath}$, *i*-$\breve{\imath}$, 4-$\breve{\imath}$, and the hemihedral planes 1, 2, 3-$\breve{3}$, 2-$\breve{\imath}$. $O : 4\text{-}\breve{\imath} = 99° 38'$.

NATROLITE [p. 327].—According to Q. Sella (Nuovo Cimento, vol. vii, number for March, 1858) the Savite has the form and angles of natrolite, and is probably that species. He obtained $I : I = 91°$, $I : \frac{1}{3} = 116° 35'$ (116° 40′ in natrolite) $\frac{1}{2} : \frac{1}{2}$ (mac.) $= 143° 10'$ (143° 20′ in natrolite), $\frac{1}{2} : \frac{1}{2}$ (brach.) $= 142° 38'$ (142° 40′ in natrolite). He remarks that the savite occurred implanted on serpentine, and was not pure from it, and that another analysis would probably show a chemical identity.

OPAL [p. 151, and III, IV].—An artificial hydrophane prepared by Mr. Langlois (Ann. Ch. Phys. [3], lii, 331,) consists of two parts of water and three of silica. It is formed by bringing chlorid of silicium into contact with moist air.

ORTHOCLASE [p. 242, and II, III, V].—Interesting quadruplicate compound crystals of adularia from the Binnen Valley are described by F. Hessenberg in his Min. Notizen, p. 3.

The beautiful white feldspar of the Danburite locality as described by G. J. Brush (this vol., p. 70) is mostly orthoclase, though in part oligoclase. The latter is distinguished by the fine striation of the surface of cleavage.

See also *Microcline*.

OZOCERITE [p. 474, and I, III].—A paper by J. Fritzsche on Ozocerite, and its relations to the Neft-gil of the island Tscheleban in the Caspian Sea, is published in the Bullet. de St. Petersburg, 376–377, and J. f. pr. Chem., lxxiii, 321.

PARALOGITE, *N. Nordenskiold.*—A mineral called Paralogite, from Bucharei, Siberia, occurring in four and eight-sided prisms, afforded Thoreld (Bull. Nat. Moscow, 1857, 221):

$\dot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{M}n$	$\dot{N}a$	ign.
44·95	26·89	14·44	1·01	*trace*	10·86	1·85=100

Affords the oxygen ratio for $\dot{R}$, $\dot{R}$, $\dot{S}i$, 6·96 : 12·56 : 23·35. Crystallization probably trimetric. No cleavage observed. H.=7·5; G.=2·665; color white, blue or reddish-blue; lustre vitreous. BB. fuses easily to a colorless blebby glass. Occurs with lapis lazuli and feldspar. [It appears to be related to scapolite.]

PECTOLITE [p. 305, and II, III].—Greg and Lettsom have published (Man. Min., p. 213) two figures of this species. One of them has a general resemblance to the figure published of wollastonite, [Min., p. 157], as pointed out by these authors, and the same angle nearly between the planes of cleavage [*i*-*i* and -1-*i*], this angle being 95° 25′ in pectolite and 95° 23′ in wollastonite. Also *i*-*i* : 5-*i* in pectolite is given at 159° 30′, which is its value in wollastonite; *i*-*i* : 2=132° 54′ in pectolite and 132° 14′ in wollastonite. These coincidences are parallel with others in composition.

PEROFSKITE [p. 345, and II, IV].—Analyses of the perofskite from Schelingen in the Kaiserstuhl, by F. Seneca, (Ann. Ch. Pharm., civ, 371):

$\dot{T}i$ 58.95	$\dot{C}a$ 35·69	$\dot{F}e$ 6·23=100·87	}	G=4·02
59·30	35·94	5·99=101·23	}	

Occurs with mica, magnetite, pyrochlore, in small black cubes.

PHENACITE [p. 189, and V].—The optical characters of phenacite have been studied by W. Haidinger (Sitz. Akad. Wien, xxiv, 30). The refraction (which is positive) for the ordinary ray is stated to be (approximately) 1·671; for the extraordinary, 1·696.

PHLOGOPITE [p. 224, and I].—According to Websky (Zeits. Geol. Ges. ix, 310) phlogopite in crystals occurs in granular limestone with garnet and idocrase at Alt-Kemnitz, near Hirschberg.

PHOSPHORCHALCITE.—Analyses of the ehlite, a phosphorchalcite, by Nordenskiöld (J. f. pr. Chem. lxxiii, 216),

	$\dot{P}$	Cu	$\dot{H}$		
1. Ehlite, columnar,	23·03	65·22	7·50=95·75+4·34	malachite,	G.=4·131
2. " massive,	23·15	64·63	6·84=94·62+5·24	"	G.=4 ·07
3. " "	22·72	64·46	6·82=94·00+5·76	"	
4. Phosphorchalcite,	22·39	64·72	6·59=93·70+6·52	"	G.=4 ·24
5. Ehlite, from Ehl,	22·51	66·55	9·03, Fe 2·11, C *trace*=100		G.=4·198

Nordenskiöld hence concludes that ehlite and phosphorchalcite are identical, and the formula $Cu^5\dot{P}+2\dot{H}$.

Hermann objects to the conclusion, and calls the species $Cu_5\dot{P}+2\dot{H}$, *Dihydrite;* the species $Cu^5\dot{P}+3\dot{H}$, *Ehlite;* and compounds of the two, *Phosphorchalcite* (including all the above analyses). The composition deduced by Kuhn and Rhodius $Cu_2\dot{P}+3\dot{H}$ does not appear to exist, and the ehlite of the formula $Cu_4\dot{P}+2\dot{H}$ is nothing but libethenite.

PLATINUM.—On platinum in Borneo, Dr. Bleekerode, in Pogg., ciii, 656.

PLOMBIERITE.—See *Zeolite.*

PYROPHYLLITE [p. 303 and I, V].—A part of the so-called agalmatolite, as shown by Brush (this vol., p. 68) is a *compact* pyrophyllite. He obtained $\ddot{S}i$ 65·95, $\ddot{A}l$ (with some Fe,) 28·97, Ca 0·22, K, Na 0·25, $\dot{H}$ 5·48. Walmstedt, as Prof. Brush observes, found the same composition for some agalmatolite, and suggested the relation to pyrophyllite.

PYROXENE [p. 158, and I, II, V].—Different crystals are figured and described by Hessenberg in his Min. Notizen, p, 18.

Ardiopside from chlorite schist in the Zillerthal, afford L. Barthe, (Sitz. Akad., Wien, xxiv, 290):

$\ddot{S}i$	$\ddot{A}l$	Ca	Fe	Mg	ign.	
48·47	8·22	21·96	4·30	15.59	0·73=99·27	G.=3·395

See further under *Hornblende.*

REALGAR [p. 31].—A crystal of the realgar of Binnen Valley, Switzerland, has been figured by Hessenberg (Min. Not., p. 14), in which there is the new plane $-2i$, and another from Bereskow with the new planes i-6 and 4-2.

RŒMERITE, *Grailich.*—This new mineral described by J. Grailich (Sitz. Akad Wien, 1858, xxviii, 272) comes from the Rammelsberg Mines. It is coarse granular, the grains partly crystalline. Form monoclinic; the crystals simple prisms O, I, i-i. Inclination of the vertical axis ($=O : i\text{-}i$)=101° 1′, $O : i\text{-}i$=90°, $I : i\text{-}i$=129° 18′, $I : I$ (front) 101° 24′, $O : I$=98·30 and 81° 30′. Cleavage clinodiagonal (i-i) perfect. Color rust-brown to yellow; translucent; lustre between greasy and vitreous; H.=2·7; G.=2·174 (mean between 2·15 and 2·18); taste saline, astringent, vitriolic. Composition (mean of two analyses by L. Tschermak):

$\ddot{S}$	Fe	Fe	Zn	Mn	Ca	Mg	$\dot{H}$	Gangue	
41·54	20·63	6·26	1·97	*trace*	0·58	*trace*	28·00	0·50	=99·48

whence the formula $\dot{R}\ddot{S}+Fe\ddot{S}^2+12\dot{H}$. BB. the reaction of iron and zinc.

Grailich suggests that coquimbite, according to a specimen in the museum at Vienna, has the optical and other characters of the rœmerite, and the species may turn out identical, although the analyses and crystallographic characters mentioned in the books are different.

SAMARSKITE [p. 355, and II, IV].—Specific gravity, according to H. Rose (Pogg. ciii, 329) of three specimens 5·625, 5·617, 5·6142; another 5·717; according to von Peretz, another 5·68; and according to Chandler, others 5·746, and 5·739. Samarskite gives out a faint light on heating, and diminishes in density, one of 5·601 becoming reduced to a density of 5·485, 5·407, and 5·3736; and another of 5·715 to 5·3735.

SARCOLITE [p. 200, and II].—A crystal of sarcolite from Vesuvius is figured by Hessenberg (Min. Not., p. 14), having the planes O, i-i, I, i-2, 1-i, 1, 3, 3-3. $I : 3$=105° or by calculation 104° 52½′.

SAUSSURITE [p. 254, and II, IV].—The saussurite of the euphotides of Mt. Rosa in the Alps, has been examined by T. S. Hunt (this Jour. Sci., xxv, 437), and ascertained to be compact epidote or zoisite (a lime-alumina epidote). H.=7, G.=3·3—3·4. He observes that the analyses of Boulanger of the saussurite of Mt. Genèvre and Orezza made it to be the same. It is related to the massive white garnet of the Green Mts. in Canada, which along with serpentine and hornblende, constitutes a variety of euphotide rocks.

SAVITE.—See *Natrolite.*

SCHRÖTTERITE [p. 337].—J. W. Mallet has described schrötterite from the Falls of Little River, on the Sand Mountain, Cherokee county, Alabama (this vol., p. 79.) It is an incrustation over half an inch thick and partly stalactitic, and when broken resembles gum arabic, being translucent or nearly transparent with a faint brownish tinge. H.=3·5; G.=1·974. Composition (mean of two analyses):

$\dot{S}i$	$\dot{A}l$	$\dot{H}$	$\dot{Z}n$	$\dot{F}e$, $\dot{M}g$	$\dot{S}$
10·53	46·48	41·09	0·77	*trace*	0·80=99·67

affording the formula $\dot{A}l^4\dot{S}i+20\dot{H}$.

SELADONITE [p. 116, 511, and I].—A green earth from Kaaden in Bohemia, a product of alteration, afforded v. Hauer (Jahrb. k. k. Geol. Reichs., 1856, 845):

$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{H}$, $\dot{C}$
41·0	3·0	23·4	8·2	2·3	3·0	19·3

The composition is near that of the green earth of Mt. Baldo. It occurs as a plastic mass of a fine green color, connected with basaltic tufa.

SERPENTINE [p. 282, 511, and I, II, III, IV, V].—A slaty serpentine resembling antigorite, from "Windisch Matrei" in the Kalser Valley, Tyrol, H.=3·5, and a fibrous variety, (metaxite), from the same place, H.=2, afforded Dr. H. von Gilm (Sitz. Akad., Wien, xxiv, 287):

	$\dot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{F}e$	$\dot{H}$	
1. Slaty,	42·42	0·65	38.05	5·71	12·91= 99·74	G=2·593
2. Fibrous,	42·19	0·62	38·71	5·98	12·54=100·04	G=2·564

The composition is that of serpentine.

T. S. Hunt on Ophiolites, this vol., p. 234.

SIDEROPLESITE.—See *Chalybite.*

SILVER GLANCE [p. 37, and I, V.].—Breithaupt has described (Berg. u. hütt. Zeit., xvii, 85) a cupriferous silver glance under the name *Ialpaite* (derived from Jalpa, its Mexican locality). It is blackish lead-gray, and malleable like ordinary silver glance, with monometric cleavage. G.=6·877—6·890. Composition, according to R. Richter:

S 14·36 Ag 71·51 Cu 13·12 Fe 0·79

affording the formula $(\frac{3}{4}\,\dot{A}g+\frac{1}{4}\dot{C}u)\,\dot{S}$.

SODALITE [p. 229, and II].—A twin of sodalite is described by Hessenberg (Min. Not., p. 17) in which composition is parallel to a trapezohedral face. The usual mode is parallel to an octahedral face.

SPARTAITE.—See *Calcite.*

STILBITE [p. 332, and III, V].—Stilbite from the Seiser Alpe, having G.=2·0, afforded Bukeisen (Sitz. Akad. Wien, xxiv, 286):

$\dot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{H}$
52·84	16·30	11·79	17·16=98·09

leading to the usual formula.

[Bukeisen writes the formula $\dot{C}a\,.\,\dot{A}l+2(\dot{H}^3\,.\,\dot{S}i_2)$. Stilbite has the oxygen ratio of feldspar 1 : 3 : 12, with the addition of the water; and this relation, (which is part of a general one between the zeolite group and feldspar group,) is wholly disguised by the above arrangement of the constituents. Moreover, in these hydrous silicates, related to the anhydrous, it is altogether probable that part or all of the water is basic instead of acid in its relations, and that the tendency to take up water depends

on the acid requiring a larger supply of base; 1+8 : 12, (=4 : 12,) becomes by the addition of the water 10 : 12; or if two parts only of the water be basic, 6 : 12=1 : 2 with 4$\dot{H}$ in excess.—J. D. D.].

TANTALITE [p. 351, and III, IV, V].—Analyses of the Kimito and Tamela tantalite by Weber in H. Rose's laboratory (Pogg. civ, 85):

	$\ddot{Ta}$	$\ddot{Sn}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Cu}$	$\dot{Ca}$	
1. Kimito,	75·71	9·67	9·80	4·32	*trace*	——	= 99·50
2. "	76·81	9·14	9·49	4·27	0·07	0·41	=100·19
3. Tamela,	83·90	0·66	13·81	0·74	0·11	——	= 99·22

Sp. gr. of 2, 7·270 in pieces and 7·277 in powder; of 3, 7·383 in pieces, and 7·414 in powder. Rose mentions that the process of analysis followed by Berzelius was not satisfactory. In the same place, Rose cites and reviews other analyses. The tantalite analyzed by Wornum [Min. Anal., 6], was probably from Kimito, where alone the variety containing much tin occurs. The variety with little tin has G.=7·311—7·943, and is found both at Tamela and Kimito; this is the *Tantalite* of Nordenskiöld and the other, the tin and manganese kind, his *Ixiolite* [see Suppl. V]. Oxygen ratio for $\dot{R}$, $\ddot{Sn}$, $\ddot{Ta}$, in 1, 3·14 : 2·07 : 14.29; in 2, 3·20 : 1·95 : 14·49; in 3, 3·24 : 0·14 : 15·82. The ratio of oxygen of bases and acids is nearly 1 : 5

But Rose observes that the neutral artificial compounds of tantalic acid which he has formed have the ratio 1 : 4. He says further, that he has obtained compounds with potash and soda in his researches, having the same ratio as above, but the combination was not definite; and also that in the case of the Tamela tantalite, the protoxyd of iron may be extracted by prolonged washing. He hence suggests, that the true ratio for the native tantalites is 1 : 4; and that other ratios are results of alteration leading to an excess of acid.

THERMOPHYLLITE, *Nordenskiöld.*—A mineral from Hopansuo near Pitkaranda in Finland, described by Hermann (J. f. pr. Chem., lxxiii, 213). In crystals and grains in an amorphous steatite-like base, which is probably amorphous thermophyllite. Cleavage perfect; form not distinct; color light-brown to silver-white; lustre pearly; H.=2·5; G.=2·56. BB. exfoliates like pyrophyllite and vermiculite. Resembles chlorite. Composition:

$\ddot{Si}$	$\ddot{Al}$	$\dot{Fe}$	$\dot{Mg}$	$\dot{Na}$	$\dot{H}$
43·12	4·91	1·99	34·87	1·33	13·14=100

whence the oxygen ratio for $\dot{H}$, $\dot{R}$, $\ddot{R}$, $\ddot{Si}$, 11·68 : 14·04 : 2·88 : 22·40, and the formula $(\dot{R}^3, \ddot{R})\ddot{Si}^{\frac{4}{3}}+2\dot{H}$.

THORITE.—The annexed observations on orangite are from a letter from E. Zschau to G. J. Brush. The following are the measurements of two crystals of orangite (Thorite). The form is a dimetric prism terminated by a pyramid (planes *I* and 1). The corresponding angles in zircon are added:

	Orangite.	Zircon.
I: 1= ∞P : P=	132½°	132° 10′
1 : 1= P : P=	123½°	123° 19′
	84½°	84° 20′

The measurements were made with a common goniometer, and for the present, until other and better crystals are obtained, orangite must be considered as undoubtedly isomorphous with zircon. On the more imperfect of the two crystals, the prismatic face *I* is very large, almost as large as in a long prism of zircon. In the other crystal, these faces are very small, but sufficiently well developed to be easily measured. The crystals appear to have a perfect cleavage, in the direction *I* (∞P), and one less perfect in the direction of the diagonal *i-i*. A portion of the best crystal is covered with zircon, and of that variety of form in which the prism is either only slightly or not at all developed. The planes on the zircon appear to be parallel to those of the orangite. Zircon, xenotime, and orangite are, therefore, alike *dimetric*. One specimen of orangite in my possession weighs 2½ ounces, and shows the faces *I* and 1.

TORBANITE, *Greg & Lettsom.*—A coal at Torbane and other places near Bathgate in Linlithgowshire which has been partially changed by heat. It is used for the extraction of lubricating oils. *Greg & Lettsom's* Man. Min., 16.

TRICHALCITE. *Hermann.*—A green arsenate of copper from the Turjinsk Copper Mine, resembling tyrolite, described by Hermann (J. f. pr. Chem., lxxiii, 212). Lustre silky; H.=2·5. BB. decrepitates yields much water and becomes dark-brown; fuses on charcoal in the outer flame to a pearl, and in the inner yields a bead of copper. Composition:

$\ddot{A}s$ 38·73 $\dot{P}$ 0·67 $\dot{C}u$ 44·19 $\dot{H}$ 16·41=100

whence the oxygen ratio for $\dot{H}$, $\dot{R}$, $\ddot{A}s$, 5·27 : 5 : 3·22. Taking it at 5 : 5 : 3, the formula is $\dot{C}u_3\,\ddot{A}s + 5\dot{H}$.

UNIONITE [p. 239].—The unionite of Silliman has been re-analyzed by G. J. Brush, on a part of the original specimen examined by Silliman, and found to be a white lime-epidote. It contained:

$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	ign.
40·61	33·44	0·49	24·13	*trace*	2·22

Specific gravity 3·299. The specimens analyzed by Smith and Brush were received by them from Silliman, jr., but owing to error in the collector who sent them to Silliman, they were not the true unionite. This vol., p. 69.

ZEOLITES.—Mr. Daubrée has given an account (L'Institut, No. 1276, June, 1858) of Zeolites now forming from the thermal waters at Plombières in the remains of an old Roman aqueduct. Among the species, the most common are *chabazite* and *apophyllite*. Both are in fine transparent crystals. The chabazite occurs in the bricks and apophyllite in the lime mortar, which shows that their elements are derived from the material in which they occur. Besides these, the following are also mentioned, though with some doubt, *scolecite*, *harmotome*, *gismondine*, *hydrated carbonate of magnesia*, in pearly plates (the plates rhombic, optically biaxial in a plane normal to that of the laminæ). There are also in the cavities of the masonry *hyalite* and other varieties of opal, and aragonite in acute bipyramidal crystals.

Plombierite.—In cavities exposed to the direct jet of thermal water, a gelatinous substance is precipitated which hardens in the open air, becomes opaque snow-white. It is a hydrated silicate of lime, of the composition $\dot{C}a^3\,\ddot{S}i^2 + 6\dot{H}$. It differs from okenite, and the author proposes for it the name *Plombierite*.

These facts, as Daubrée observes, sustain the conclusion that the zeolites filling cavities in rocks were of aqueous origin and subsequent in formation to the including rock.

Appendix.

FURNACE CRYSTALLIZED PRODUCTS.—At the lead and silver furnace at Ems & Holzappel, hexagonal crystals of a compound of antimony, copper, and nickel, have been observed by F. Sandberger (Pogg. ciii, 526). They consist of Antimony 58·57, copper 32·73, nickel 8·97.

CRYSTAL MODELS.—Models of crystals in wood, well made and convenient for study, may be purchased of A. Krantz, at Bonn, at 16 thalers (or $12.00) for 114 pieces. The same kind of models may be obtained also of H. Dauber, at Gandenheim, in the Duchy of Brunswick, at 11 thalers ($8.25) for 80 pieces, or 8 thalers ($6.00) for 50 pieces: orders are received by the booksellers in Brunswick.

Glass models of great beauty and perfect for class illustration, are sold by F. Thomas, at Siegen, Westphalia. They are made of plate glass; the fundamental forms with their axes within, and the various secondary forms with the fundamental form of each enclosed. The whole collection contains 142 forms; the price varies from 16 silver groschen (40 cents) to 156, according to their complexness; for the whole 142, the price is 215 thalers ($161.30). The catalogue issued by Mr. Thomas announces that the first publication on this kind of model is found in Poggendorff's Annalen, vol. 95, 1855. He should go back of this to the writer's Mineralogy, first edition, 1837. A collection of 50 models, of precisely the same kind, were made by the writer in the year 1836, and each edition of the Mineralogy has contained a paragraph recommending the method (first edition at p. 29, and the last at p. 32). Mr. Thomas's models are made with superior skill, and we commend them strongly to all institutions where the subject of crystallography is taught. The charge for them is reasonable.

Arrangement of the Hydrous Silicates.

As many of the hydrous silicates in the Mineralogy are arranged under the species from which they are supposed to have been derived, and are not included in the section of Hydrous Silicates, the following classified catalogue of the whole is here introduced.

The two divisions adopted in the Mineralogy, (1) the magnesian and iron series with related species, and (2) the alumina series, are retained.

The Talc and Pyrophyllite sections are parallel to one another, one magnesian and the other aluminous; both have species with a soapy feel; pyrophyllite has the same oxygen ratio as talc, and each passes into compact soapy varieties, agalmatolite being in part, as Prof. Brush has shown, a pyrophyllite soapstone.

In the Talc section, the oxygen ratio is augitic or nearly so (1 : 2 or 1: more than 2); and in the Chlorite section, it is near that of the Mica and Andalusite sections (1 : $1\frac{1}{3}$, to 1 : 1 and 1 : less than 1). The hydrous micaceous species of the Phyllite group is related to the anhydrous micas.

Again, the *Augitine*, *Garnetine* and *Apophyllite* sections are parallel in composition and crystallization with the *Augite*, *Garnet* and *Mica* sections among the anhydrous species; the Zeolite section, as shown in the Mineralogy, is parallel with the Feldspar section, and the Datholite section with the Andalusite section and particularly the Euclase group.

Apophyllite, if the water be considered as basic, has the same oxygen ratio between the bases and silica as muscovite, that is 5 : 6. We do not say that the relation thus indicated is a true one, although adopting it for the present.

Chrysolite and calamine are related in form; if we take $a : b : c$ as the axes of chrysolite, then $a : b : 1\frac{1}{2}c$ will be the axes of calamine. Prehnite also comes near chrysolite, if the dome of most common occurrence, $\frac{3}{2}$-$\bar{1}$, be made the plane I; for in that case, $I : I = 90°\ 15'$, $2\text{-}\bar{1} : 2\text{-}\bar{1} = 80°\ 4'$ and $99°\ 56'$, and $1\text{-}\bar{1} : 1\text{-}\bar{1} = 118°\ 14'$. The cleavage in this case becomes brachydiagonal, as it is in most species with a single perfect cleavage.

It is not possible to make a perfect arrangement of these hydrous species until the chemical relations of the contained water are better understood. The method of classification adopted brings the species together into natural groups, and the arrangement will be found convenient for a cabinet.

DIVISION I.

I. TALC SECTION.

1. Talc Group.

Talc (Rensselaerite), Spadaite,
Meerschaum, Neolite.
Anthosiderite, Chlorophæite, Chlorophanerite, Quincite.

2. SERPENTINE GROUP.

Serpentine,
Deweylite (Kerolite and Gymnite),
Hydrophite,
Aphrodite,
Chloropal,
Schiller Spar,
Saponite,
? Boltonite,
? Villarsite.

3. GLAUCONITE GROUP.

Picrophyll,
Pyrallolite,
Monradite,
Palagonite,
Seladonite,
Crocidolite,
Glauconite,
Strakonitzite.

II. CHLORITE SECTION.

1. PHYLLITE GROUP.

Margarodite (Gilbertite, Damourite),
Astrophyllite,
Euphyllite,
Ottrelite (Phyllite),
Stilpnomelane (? Chalcodite),
Eukamptite (Voigtite),
Epichlorite,
Fahlunite (Bonsdorffite, Esmarkite, Chlorophyllite),
Gigantolite (Iberite),
Aspasiolite,
Praseolite,
? Huronite.

2. CHLORITE GROUP.

Hisingerite,
Thuringite,
Pyrosclerite,
Clinochlore (Tabergite), IV.
Chlorite (Pennine, Leuchtenbergite, Pseudophite), VI.
Ripidolite,
Metachlorite,
Delessite,
Aphrosiderite,
Cronstedtite,
Sideroschisolite.

3. MARGARITE GROUP.

Margarite, Clintonite, Chloritoid.

DIVISION II.

I. PYROPHYLLITE SECTION.

1. PYROPHYLLITE GROUP.

Pyrophyllite, Cimolite.
Doubtful.—Anauxite.

2. PINITE GROUP.

Pinite, Liebenerite,
Gieseckite,
Pyrargillite, Weissite, Dysyntribite, Parophite.

3. HALLOYSITE GROUP.

Kaolin, Lenzinite,
Pholerite, Severite,
Halloysite, Volkonskoite.

Bole, Sinopite, Stolpenite, Oropian, Onkosin, Teratolite.—Clays.

4. ALLOPHANE GROUP.

Schrötterite, Allophane, Collyrite.

APPENDIX.—Scarbroite, Dillnite, Miloschine, Delanovite, Montmorillonite, Smectite, Killinite.

II. AUGITINE SECTION,

(Related to the Augite Section of Anhydrous Silicates.)

1. PECTOLITE GROUP. IV.—(Related to the Augite Group.)

Pectolite, Laumontite,
Okenite, Leonhardite.

2. CATAPLEIITE GROUP. VI.—(Related to the Beryl Group.)

Catapleiite, ? Pyrosmalite.

3. DIOPTASE GROUP. VI.

Dioptase,
Chrysocolla, Demidoffite.

III. GARNETINE SECTION.

(Related to the Garnet Section.)

1. CALAMINE GROUP. III.—(Related to the Chrysolite Group.)

Calamine, Prehnite.

2. CERITE GROUP. VI.—(Related to the Phenacite Group.)

Cerite.

3. TRITOMITE GROUP. I.—(Related to the Garnet Group.)

Tritomite.

4. THORITE GROUP. II.—(Related to the Scapolite Group. See this Suppl., p. 359.)

Thorite.

5. CARPHOLITE GROUP.—(Related to the Epidote Group?)

Carpholite.

IV. APOPHYLLITE SECTION.

Apophyllite, Gyrolite.

V. ZEOLITE SECTION.

(Related to the Feldspar Section.)

1. ANALCIME GROUP.—(Related to the Leucite Group.)

Analcime, Glottalite, Ittnerite.

2. CHABAZITE GROUP.—(Related to the Nepheline Group.)

Chabazite, Gmelinite, Levyne.

3. GISMONDINE GROUP.—(Related to the Nepheline Group.)

Gismondine, Edingtonite, Faujasite.

4. NATROLITE GROUP.—(Related to the Feldspar Group.)

Harmotome, Scolecite,
Phillipsite, Faroelite,
Thomsonite, Mesolite.
Natrolite,

5. STILBITE GROUP.—(Related to the Feldspar Group.)

Epistilbite, Brewsterite,
Heulandite, Stilbite.

VI. DATHOLITE SECTION.

(Related to the Andalusite Section, Euclase Group.)

Datholite.

ART. XL.—*A New Mode of Making Commercial Caustic Soda;* by JOHN M. ORDWAY.

IN the manufacture of soda by Le Blanc's process, much trouble is occasioned by the unavoidable presence of unoxydized sulphur compounds in the lixivium of the crude soda or "black balls." In that branch of the business which is most extensively carried on, experience has shown methods by which the difficulty is overcome with tolerable success, and accordingly the manufacturer generally aims to produce a good soda ash as the material from which other desired products are to be made. But many consumers require a caustic alkali, and it is inconvenient and expensive for each one to have special kettles or cisterns to prepare what the soda maker could, with mutual advantage, furnish ready for use. Caustic soda has, therefore, begun to be a regular article of commerce, and the demand would be very great, if the price of a good article bore a juster ratio to that of soda ash. To reduce the cost to a minimum it is evidently necessary that a

caustic soda of fair quality should somehow be obtained directly from the crude soda lye, without the preliminary process of making a clear, desulphurized carbonate. But how this can be done economically, is a problem whose answer has not yet perhaps been reduced to the fewest possible terms. Yet the following process is but one remove from the greatest conceivable simplicity, while it has been found by actual working on the large scale to be sure and effectual, and so easy of execution that any man of good common sense can, by a few trials, acquire all the necessary experience.

The "black balls" made in the usual manner are broken up and fully exhausted by a serial lixiviation, so as to make a solution standing at 15° Baumé. A stronger liquor cannot be made fully caustic. The solution is heated to the boiling point and treated with milk of lime prepared beforehand by slacking lime with about six times its weight of water. Three pounds of lime fully suffice for each cubic foot of the lye.

The resulting carbonate of lime, after thorough draining, may be dried by waste heat and used in making more "black balls."

The clear caustic solution is to be evaporated till it stands at about 45° B.—any salts that may fall being dipped out from time to time. To a quantity of this thick red liquor contained in a cast-iron kettle, so set as to admit of being strongly and uniformly heated, we now add as much fine sesquioxyd of iron as shall somewhat exceed in weight the amount of dry hydrate of soda contained in the liquor. By a little practice one can soon learn to guess quite correctly at the quantity of oxyd required for any particular kettle. There should be so much that when the mixture is dried down with constant stirring it may become a dry substance, and not fuse at a heat just below dull redness. During this drying operation, ammonia is given off in abundance, resulting perhaps from the breaking up of the cyanids commonly present in crude soda. Peculiar, but slight and not unpleasant odors, also arise from the decomposition of the organic impurities of the water used in lixiviation. At last when the water is all driven off, the mixture rapidly absorbs oxygen, and from a black or dark brown becomes rust colored throughout. The fire is now smothered and the roasted product, after standing in the kettle an hour or two with an occasional stirring, is thrown out into a clean iron vessel. As soon as the kettle is cold enough to be in no danger of cracking, it is filled again with a fresh charge, and, excepting these intervals of cooling, the work is continued night and day without intermission.

The rust colored powder, when a sufficient quantity has accumulated, is treated with hot water so as to get a solution standing at about 30° B. This liquor, after standing till it has become perfectly clear, is drawn off and boiled down, by successive gra-

dations, till all the free water is expelled. Soon after the commencement of the evaporation, saline matter begins to fall, consisting of sulphate, sulphite, and carbonate of soda, and this deposit—which should be dipped out as it accumulates at the bottom—continues to form as long as the solution remains at 32° B. Afterwards some chlorid of sodium falls, if there is any present, but when the strength gets beyond 36 B. there is no farther deposition. The first kettle of the set, or the melting kettle, which should be of cast-iron, is kept full till the solution indicates 42° B., and is then finished off without more filling, since the liquor froths a great deal towards the last, and must have plenty of room to spread itself. Finally, the fire is urged till the hydrate of soda is fused, and, if the mass shows any rednes indicative of imperfect roasting, a few handfuls of nitrate of soda are cautiously thrown in to insure complete oxydation. It seldom takes more than one per cent of nitrate to destroy any remaining sulphid. When the melted soda has become quiet and a little of it poured out on a cold iron plate, shows by immediate solidification and its white color that all is right, the whole is laded out into iron molds, from which it is transferred as soon as cold to air-tight casks. When the operations have been conducted with ordinary care, the product is white or a little greyish, and is pure enough for all common uses.

The main feature of this process is an oxydizing operation, in principle not very unlike the roasting of pyritous ores. But the sulphurets of the heavy metals can be roasted, *per se*, while sulphuretted hydrate of soda, it being by itself fusible at the requisite heat, has to be mixed with an inert substance to reduce it to the dry and porous state, and so render its particles entirely and speedily accessible to atmospheric oxygen. And this is why the brown mass must not be allowed to melt. Oxyd of iron seems to be peculiarly suitable for drying up the caustic alkali and separating its particles; and as the same oxyd will serve over and over again indefinitely, we need only enough to last till the first lots used are exhausted of alkali and drained and are ready to be used again. There is no need of drying it. Venetian red is a good form of the oxyd, but I have always used a pure earthy hematite that had first been calcined and ground. It is quite possible that oxyd of manganese, free from silica, would do as well, and probably a mixture of the two oxyds would do better than either by itself.

It may not be amiss to mention that hemispherical cast-iron kettles four feet four inches in diameter and half an inch thick at the sides and three quarters at the bottom, have been found by long trial to be very suitable both for roasting and for melting. In such a kettle 500 pounds of caustic soda may be finished off at once. Larger kettles would be hard to manage and smaller ones would cause a loss of time.

This production of caustic soda may be advantageously carried on in connection with the manufacture of a better quality of soda ash by a method sometimes resorted to. A solution of carbonate of soda cannot be made stronger than 32° B. Accordingly the crude soda lye when evaporated retains in solution all the caustic soda and sulphid of sodium and deposits a very good carbonate which is dipped out, drained, and calcined for soda ash. When the liquor shows by increasing in density beyond 32° B. that the carbonate has all fallen, it can be transferred to other kettles, evaporated till it gets very dense, and then mixed with oxyd of iron and dried down. The roasted product will give a good caustic soda by solution, decantation, evaporation, fusion and deflagration.

ART. XLI.—*On the Preparation of some Pure Sulphates, and particularly of Sulphate of Copper;* by HENRY WURTZ, Prof. Chem. National Med. Coll., Washington.

(Read before the American Association for the Advancement of Science, at Baltimore, April, 1858.)

COMMERCIAL *blue vitriol* always contains sulphate of protoxyd of iron, which cannot be separated by crystallization, owing to the fact, determined by Mitscherlich,* that ferrous sulphate, when crystallizing with sulphate of copper, assumes the pentehydrated composition and triclinic form of the latter, and forms with it homogeneous crystals. It has appeared to me desirable, therefore, that some special method be devised for the separation of the iron, both in order that the chemist may possess a source of pure compounds of copper, and because the presence of iron must be injurious in those processes of dying, calico-printing, etc., in which blue vitriol is used, and in the preparation of the cupriferous pigments, *verdigris*, *Paris green*, etc.

In undertaking this, my aim has been to produce a method by which the iron may be directly separated or abstracted from the solution without the permanent introduction of any foreign substance. My process consists essentially of two steps, the first of which is the conversion of the ferrous into *ferric* sulphate, by boiling with a little *deutoxyd of lead*, and the second is the *complete* precipitation of the ferric sulphate, by boiling with a little *carbonate of baryta*. The hot solution is then filtered and allowed to crystallize, when large crystals of beautiful form and color are obtained, containing no trace of iron.† Deutoxyd of lead is prepared for this purpose by boiling *minium* with dilute nitric or acetic acid in the usual way, but minium itself, if free from

* Gemlin's Handbuch, iii, 461. † Specimens were exhibited to the Section

soluble impurities, may be used directly in ordinary cases, although a portion of the oxyd of copper also is thereby precipitated. *Deutoxyd of barium* is of course also applicable.

In cases where the presence of a little *lime* in the product is of no moment, as for the use of the calico-printer and manufacturer of pigments, carbonate of lime may be substituted for that of baryta.

In addition it may be remarked that if the blue vitriol contains traces of *manganese*, as is extremely liable to occur, this contamination, as would appear from the observations of Schönbein* and Wolcott Gibbs,† must also be entirely removed.

The same treatment is evidently applicable to some other sulphates, and I therefore present it as a general method for the removal of iron from the sulphates of bases precipitated with difficulty by carbonate of baryta, namely, those of *the alkalies, magnesia, manganese, zinc, cadmium, mercury, nickel, cobalt* and *protoxyd of iron*. Of these the most important one practically is the sulphate of magnesia. The mode of proceeding with this would be precisely similar to that with the copper salt, as it would be also with the sulphates of zinc, cadmium, mercury, nickel, and the alkalies. With regard to the manganous sulphate, it must be remembered that deutoxyd of lead, as observed by Schönbein, wholly precipitates sulphate of manganese from its boiling solution; so that the deutoxyd must be used only in small excess over the necessary quantity. The same precaution applies, in a modified manner, to the treatment of the cobaltous sulphate, because Gibbs states that the salts of this metal are also partially precipitated by long boiling with an excess of the deutoxyd, passing first to a higher state of oxydation.

As to the protosulphate of iron, I have already (New York Jour. Pharmacy, i, 229) recommended the use of carbonate of baryta for the removal from it of sesquioxyd of iron. In the same paper (which has, I believe, entirely escaped notice from other Journals, owing to the irregularity with which the *exchanges* of that publication were effected) I have given, among other observations upon the purification of copperas, another method of obtaining its solution free from ferric sulphate, namely, by acidulation with sulphuric acid and agitation with a little pulverized *protosulphid of iron*, by which the sesquioxyd is immediately reduced to protoxyd.

To return again to the sulphate of magnesia, before leaving the subject, I must add that the treatment with carbonate of baryta, according to a former observation of my own,† must re-

* Pogg. Annalen, lxxviii, 162.

† Contributions to Analytical Chemistry, Am. Jour. Sci. [2], xiv., 204.

† New York Jour. Pharm., i, 161; also Ch. Gaz., 1852, 268; Ph. J. and Trans., xii, 77; Dingl. Pol. J., 125, 275; also quoted in Lieb. & Kopp's Jahresbericht, 1852, p. 360.

move also entirely the *sulphate of lime* which usually contaminates commercial Epsom salt; for, as I have there stated, carbonate of baryta totally precipitates gypsum from its solution, even in the cold; and I have there proposed it as a means of removing the gypsum from spring or sea-water which is to be used in steam boilers, (thus preventing *incrustations*,) as well as from the brine of salt works. I have since found that *carbonate of lead* has the same power of precipitating gypsum, and may possibly be a *cheaper* agent for the purpose than carbonate of baryta, considering the facility with which the lead may be *recovered* from the resulting mixture of sulphate of lead and carbonate of lime, in a metallic form.*

* Although not wholly relevant to the subject of this paper, I may be pardoned a few additional remarks upon this subject of the removal of gypsum from waters. When we call to mind that the *crystallization* of the gypsum from its hot solution is the *principal*, and usually the *only* cause of the formation of the destructive boiler-crusts; and that, leaving out of view the injury sustained by the boiler, the actual *loss of heat* through the non-conducting power of the crust and other causes connected with it, has been shown to amount, in the case of *locomotive boilers* (in France), in many cases to 40 per cent of the fuel consumed, the subject may be considered worthy of further attention; and I shall, therefore, present some brief *calculations* bearing upon it.

In a saturated solution of gypsum then (say, in round numbers, 1 part in 400) each 800 lbs. = 800 pints = 100 gallons will contain 2 lbs., and each 1000 gallons 20 lbs. of sulphate of lime; which is equivalent to 24 lbs. of pure carbonate of baryta, or a little over 31 lbs. of pure carbonate of lead. But water used for steam purposes, sea-water for instance, is seldom or never a *saturated* solution of gypsum. Let us take von Bibra's analyses of the waters of the Atlantic Ocean, (Liebig & Kopp's Jahresb. für 1850, 621,) collected at four different times, at as many widely distant places. These give in 100 parts 0·205, 0·156, 0·16, and 0·19 parts of sulphate of lime. For the sake of simplicity, take 0·2: then 1000 gallons = 8000 lbs. contain 16 lbs. of gypsum, The quantity of carbonate of baryta equivalent to this is 19·2 lbs., and of carbonate of lead 25 lbs. Thus one ton (2000 lbs.) of carbonate of baryta, which some years since sold in England (in the form of ground *witherite*) for $20, is theoretically sufficient to separate the gypsum from 100,000 gallons of the water of the Atlantic. On referring now to the evaporative powers of different coals, as determined by Walter R. Johnson, for the United States Navy Department, (Taylor's "Statistics of Coal," introduction, p. lvii; Knapp's Chem. Technology, Am. Ed. i, 48,) we there find that 1 lb., for instance, of Lackawanna anthracite (considered in New York superior for steam purposes) produces 8½ lbs. of steam from cold water; so that to evaporate 100,000 gallons would require $\frac{8 \times 100.000}{8\frac{1}{2}}$ = 94,000 lbs., or 47 tons. 40 per cent of such a quantity is over 18 tons.

I do not, however, by any means recommend the application of this principle to *ocean steamers*, on account of *practical* difficulties, which I see no way to overcome. But *on land* the application is a matter of perfect simplicity. It is only necessary to have the *tanks* from which the boiler is supplied, larger, and to have more of them. While the process of mixture and agitation with the carbonate, and precipitation by standing, is going on in one tank, water may be used from another which has undergone the process. The idea seems to me to be especially applicable to *locomotives*, for which even sea-water may then be used.

Art. XLII.—*Geographical Notices.* No. IV.

The Expedition to verify certain Surveys on the rivers Atrato and Truando, in the Republic of New Granada.—As no complete official report of this survey has yet been published, it is only possible to give at the present time some general information respecting it.

The expedition was organized to verify the survey of the "Atrato inter-oceanic canal route," made by Capt. Wm. Kennish, of New York, and published under the auspices of a company already organized for the prosecution of the enterprise; Lieut. S. A. M. Craven, U.S.N., and Lieut. N. Michler, of the topographical engineers, were selected to conduct the party—the former being intrusted with the care of the hydrography, and the latter of the topography of the route.

They sailed from New York in the U. S. surveying schooner, "Varina" on the 16th of October, 1857, and arrived in the Gulf of Darien off the mouths of the Atrato early in December.

On the 8th of that month they entered the Caño Coquito, one of the mouths of the Atrato, and continued up the main stream for a distance of about ninety miles, as far as the mouths of the rivers Sucio, Salaqui, and Truando.

The Atrato, throughout this entire distance, was found to be a large and beautiful stream, flowing nearly due north, of an average depth of from forty to fifty feet, and a width of from one to two thousand feet, presenting no obstacle to uninterrupted navigation, excepting at its mouths.

In the Caño Coquito, the mouth which has been proposed as the outlet of the canal, the average depth of the water is much less than in the main stream, shallowing to only a few feet on the bar at its entrance. This difficulty is to be obviated by closing some or all of the other mouths, after deepening the Coquito by dredging machines, on the supposition that the force of the current will of itself be nearly if not quite sufficient to keep the channel clear of the soft deposit which now chokes it up. The velocity of the river current is not more than one and a half to two miles per hour, as in the whole distance traversed by the party the rise in elevation is exceedingly gradual, having been estimated at from twenty to thirty feet.

Leaving the Atrato, the party next ascended the Truando as far as the river Nercua, thence following the latter stream, in a northerly direction, for about twelve miles to the river Hingador, at which point the route diverged to the westward, crossing the chain of the Cordilleras. For a few miles above its junction with the Atrato the Truando flows mostly through extensive grassy lagoons, wearing its way in a narrow channel through the soft

clayey deposite, of which the banks are discovered to be composed, when they appear during the drought of the dry season. Thence nearly to the Saltos or falls, its course is "amid a labyrinth of islands," through channels often almost entirely closed by drift timber. It was in this portion of the river, called the "Palisados," that the party experienced the greatest difficulties in forcing their way. Above the Palisados the river was found to widen into a broad and beautiful, though somewhat tortuous stream. Here for the first time, gravel and occasional strata of rocks began to appear in the banks. Throughout the whole course of the Truando above the lagoons, the banks were covered with a heavy growth of timber, which, while it would present an obstacle to the excavation of that portion of the canal, would be easily made to supply the lack of material near the mouth of the Atrato, where it would principally be needed. At the Saltos of Truando, where the river breaks through a narrow spur of the Cordilleras, the channel for several miles was either broken up by shallows and rapids, or confined within walls of rock of exceeding hardness, called, perhaps incorrectly, basaltic in the letter of Lieut. Craven. From the Saltos to the mouth of the Nercua the river was found to reassume its broad and open character, with banks less densely wooded than below. The Nercua is a narrow and crooked stream, flowing mostly in a rocky or pebbly bed. Throughout a great part of the distance passed over on this stream, the party were obliged to wade, owing to the shallowness of the water.

Passing up the river Hingador the party climbed up two magnificent falls, one of an apparent height of at least 150 feet, and afterwards made their way by an Indian trail along and across numerous ridges, running in various directions to the river Potumia, by which they descended to the Pacific. The ridges traversed by the party were only a few hundred feet in height, and exceedingly narrow, and the whole distance from the Nercua to the Pacific does not appear to have been more than twelve or fifteen miles. The depression in the mountains at this point is remarkable, and, when viewed from the Pacific, seems almost as if intended by nature for the facilitation of the great enterprise of inter-oceanic communication. The route of the party terminated, on the Pacific, at what was called by Mr. Kennish Kelley's Inlet, and by the natives Balia Ensenada, or rather on a sandy island exterior to the inlet, and called Isla de la playa del Potumia, located nearly in latitude 7° N.

It seems that a full and complete examination of the region between the river Nercua and the Pacific was prevented by the failure of provisions, and by previous delays caused by the inadequacy of the means of transportation provided for the party. Therefore, after a delay of two days on the Pacific, Lieut. Michler,

with his party, was compelled reluctantly to retrace his steps, and return with all possible speed to the Atrato.

Lieut. Craven made a hasty examination of the Pacific terminus of the route, and a more complete one of the mouths of the Atrato, and the adjacent shores of the Gulf of Darien. His report has already appeared in the public journals, and received the attention and comments of those interested. Lieut. Michler ran a line of levels from the Atrato to the Pacific, and mapped the Atrato to its mouths, and the important data collected by him is yet in course of preparation for the press.

With regard to the climate of the whole region, Lieut. Michler reports a delightful temperature, and cool, refreshing nights. During the whole progress of the party from ocean to ocean, scarcely any rain fell—the season being one of unusual dryness—yet the dewpoint was constantly but very few degrees below the actual temperature. The sky was often obscured by clouds, especially after 10 in the P. M., yet Lieut. Michler had satisfactory opportunities of determining, by astronomical observations, the locations of several of the principal points of the route.

Mr. Schott, the naturalist of the party, furnished himself with numerous notes, which, when published, will be of great interest to the scientific world. His extensive collections were not all received in the best condition, owing partly to the dampness of the country, and partly to accidents resulting from insufficient means of transportation.

As to the practicability of the canal, the determination of which was the main and important object of the expedition, nothing can be definitely known till the publication of the data.

Map of the La Plata Basin.—The United States government have recently published a map of the Basin of the La Plata, based upon the results of the expedition which was commanded by Comm. Thos. J. Page, U. S. N., in the years 1853–4–5–6. The map of the adjacent countries is compiled from the most reliable authorities. The country thus delineated, lies between 54° and 73° W. long. and 12° to 36° South lat. The scale is 1 : 3,000,000. A vertical section of the Rivers Parana and Paraguay, from Curumba to the sea is appended. The whole map has peculiar interest at the present time in view of the departure from this country of a large fleet to sustain the demands of the United States government upon Paraguay.

Hydrography of San Francisco Bay.—Dr. J. G. Kohl, whose investigations for the Coast Survey, in respect to the progress of discovery on the coast of the United States have been previously referred to, has published in the Berlin Zeitschr. für allgem. Erdkunde an elaborate essay on the Hydrography of San Francisco Bay, California, and a History of its discovery and exploration from the time of Cabrillo in 1542 until now.

Gold Medal to Dr. Kane.—The report of a commission of the Imperial Geographical Society of France, awarding to the family of Dr. E. K. Kane, the Gold Medal of the Society for his Arctic discoveries, is published in the May number of their Journal. The course pursued by Dr. Kane is thoroughly reviewed in terms of strong commendation. The discovery of an open sea is accepted as established, though doubts are expressed in respect to its permanency. A postscript to the report refers to an attempt made in London to discredit some of Dr. Kane's discoveries, and then proceeds to confirm the previously expressed opinion of the commission, especially in respect to the Open Polar Sea.

African Explorations.—The news of the safe arrival of Dr. Livingstone in South Africa, has been received with great interest, and there is every reason to believe that with his present attendants and apparatus, his new investigations will surpass the former in importance. A valuable service has been performed by Mr. E. Behm, who publishes in Petermann's Mittheilungen for May last, a methodical sketch of the newly explored regions in South Africa, based chiefly on the observations of Dr. Livingstone, but also derived from the researches and criticisms of Galton, Andersson, Moffat, Ladislaus Magyar, Hahn, Rath, de Costa Leals, Chaillu, Graça, &c. The article, (which extends through fifty quarto pages) discusses, 1, the physical structure and geology, 2, the hydrography, 3, the climatology, 4, the vegetation, 5, the zoology, 6. the ethnography. It is without question the most satisfactory scientific review of what is known in respect to South Africa which has ever appeared. A detailed map of that part of the continent, lying south of 8° S. Lat. is printed with the memoirs, and presents a complete indication of the present state of our knowledge in the lands north of the Orange and Limpopo rivers.

Two new volumes, the fourth and fifth of Dr. Barth's researches in Northern Central Africa have appeared in London, but have not yet been reprinted in this country. They contain an account of the journey from Lake Tsad to Timbuctoo, of his residence during seven months in that hitherto almost unknown city, and of his homeward route.

No intelligence has been received of his intrepid companion Dr. Vogel, but on the contrary, tidings have reached Europe of the death of Baron von Neimans, who had volunteered to go to Dar Fur and Wadai in search of Vogel. Baron von Neimans though only 28 years old, was well known for his observations as a traveller, several valuable articles by him having appeared in Petermann's Journal.

Lieut. Burton, who it will be remembered is penetrating to the Interior of Africa from the Eastern coast, has been heard from as far inland as ten days march from Ugógo in about 6° 30′ S. lat.,

36° 30′ E. long. from Greenwich. This is not the third part of the way from Bagamoyo to the inland sea.

The members of Dr. Baikie's expedition, are still engaged in their explorations upon the Niger. The loss of the "Day Spring," embarrassed their proceedings, and the "Sunbeam," by which its place was supplied, was not able to ascend the Niger till after the rise of its waters in July.

Rev. Samuel Crowther, one of the Missionaries of the Church Missionary Society, who has been in the company of Dr. Baikie, sends home to the Church Missionary Intelligencer, a very full journal of the chief occurrences. Although his observations are not of a scientific character, they present valuable information in respect to the native tribes; and his statements of the spread of the gospel among them, are truly surprising.

We are informed that, at a recent meeting of the "U. S. National Colored Convention," an exploring party was appointed to go to the Niger, and ascertain what inducements exist for colored men from this country to enter into commercial and agricultural pursuits, in the region of that river.

The Desert of Sahara.—The following summary in respect to the Sahara, is translated from Karl Arenz's review of the researches of Barth, Overweg, Richardson, and Vogel.

The Desert of Sahara has been represented as a low, flat plain, scarcely rising above the level of the ocean,—a vast sea of sand, upon which, besides a few craggy lines of rock that project into it here and there, there are no other elevations but those shifting mounds and columns of sand, that, like huge billows, move at the mercy of the wind,—a trackless waste, where the traveller, after many days' journey, may still look in vain for a single trace, either of vegetation or of animal life. Modern researches, however, do not sustain this view. On the contrary, they show beyond a doubt that the Sahara consists mostly of a series of table-lands of a greater or less elevation, jutting up occasionally into mountains, and sometimes divided from each other by valleys, or plains covered with sand, and apparently interminable. Let us take a rapid survey of the principal results bearing upon this point.

On their way from the shore of the Mediterranean to Ghat, Barth's party crossed three high and wide plateaus, parallel with the Mediterranean coast. First, came the Gharian plateau, 2,000 feet high, where first they ascended it, but gradually sloping as they passed on, until it terminated at the moderate height of only 500 feet. Next, the monotonous Hamadah, stretching away at a uniform height of from 1300 to 1600 feet, for 120 miles; and then, after crossing Wadys of 600 to 700 feet elevation, and miniature deserts of 1000 feet, the travellers reached the third, or the Murzuk plateau. This plateau is elevated not far from 1500 feet above

the level of the ocean. Its lowest depression is 900 to 1000 feet high, while other portions attain a height of 1800 to 2200 feet. After leaving the Murzuk plateau, the caravan, as it went toward Ghat, appears to have found a mean altitude of 1250 to 1450 feet; and so likewise for some distance to the southward of Ghat, until it came to the wild mountainous region which lies between Ghat and Air, where it entered a Wady (Adschunscher) lying at a height of 2956 feet, and situated amid mountain peaks that were roughly estimated as about 4000 feet high. From Tin Tellust in Air, the altitude of the region was estimated at 1894 feet, nor can we suppose the southern Hamadah to lie at a much greater depression.

Though the Sahara lies at such an elevation, yet we hear of no very lofty mountains there: in Air, however, we come upon a few single peaks, (the Baghtzen, Dodschen, and others,) but these are only from 3000 to 5000 feet in height. Nor are there any extensive mountain chains, unless we except the line of hills between Air and Ghat, and the Uariat which eastward of the Ghat valley stretches north and south, though even this nowhere rises to any great height. It would appear that the southern part of this quarter of the desert, is even more mountainous in its character than the northern, while this in its turn with its extensive plateaus whose scarped sides give them the appearance of gigantic blocks that have been suddenly pushed up through the ground, possesses a peculiar interest of its own. If we compare these lofty plateaus with similar elevations in Europe, we may conceive of the highest part of the Gharian as being at an equal level with the most remarkable table-lands of Europe, those of Spain and the Morea. The two other plateaus may be compared with the highest of the Swiss and South German table-lands, while the deep lying Wady (500 feet) is about the height of the elevated plains of Bohemia.

This portion of the desert is therefore not low, but lofty, not a monotonous dead-level, but a broken highland; in short, it is a series of table-lands of different elevations. Neither is this portion of the Sahara by any means a sea of sand; in fact, only a comparatively small part of it answers to such a description. But though Sahara, as far as our information extends, proves to be a high land, it does not follow that it is so throughout The probabilities of the case, however, are in favor of this conclusion. The measurements of Vogel, in the year 1853, on his route from Tripoli over Sokna to Murzuk, and thence to Bilma, show that some of the eastern portion of the desert is likewise a highland. It is true that he found the tract between the base of Gharian and Sokna much lower than elsewhere, (Boudschem is only 200 feet above the level of the ocean,) but to the southward of Sokna he ascended a narrow pass of the Black Mountains to

a plateau of 2000 feet in altitude which stretched away in an unbroken surface of from 1360 to 1590 feet, as far as Mursuk, and hence it appeared probable that the Mursuk plateau at its eastern extremity merges into the Hamadah. From Aschenumma, in the neighborhood of Bilma, Vogel writes: "I have ascertained that the Great Desert is one vast plateau formation, of the general height of from 1200 to 1500 feet."

With these data before us, based as they are upon scientific research, we are prepared to give credence to the reports of the natives respecting the mountainous character of many portions of the Sahara. The whole southern region of the Tibbus Desert (Lybian) appears from such reports to be covered with high mountains and mountain ranges; in fact, near its southern border two remarkable mountain clusters have been discovered, the Borghu and the Uadschunga, which are so elevated that the natives dress in furs. But the loftiest mountain in the region of the Tibbus, is Tibesty, to the northeast of Bilma, which, according to our accounts, is visible at the distance of four days' journey; we know, moreover, that the Tibbus, even from the remotest parts of the country, flee for refuge from the attacks of the Tuareg, to its solitary cliffs, which, with their precipitous sides, tower up from the rocky abysses at their base. These rocks are so steep that the Arabs say of them: "Your turban will fall off if you attempt to look up to their summit," and Vogel has aptly compared them to the rock upon which the fortress of Konigstein, in Saxony, is built. In regard to the westernmost and larger portion of the Sahara, we have similar reports from the natives, of mountain chains and lofty highlands; as, for instance, of the Black Mountains, which extend from the coast far to the inland, and of a mountain chain fringed on its eastern border by several oases, that of Tuat, among the rest: but especially renowned is the frowning Haghar group, with its three or four sheer, steep and dizzy walls of rock, each wall 125 miles in length; this is said to be surrounded by an immeasurable sea of sand, and to form the stronghold of the most powerful and the most predatory of all the Tuareg tribes, that of the Haghar Tuareg, who, amid these high mountain fortresses, are compelled to go clad in woolen and furs.

And yet there remains, as well in the northern part of the Sahara as in much of its western portion, room enough for vast patches of sand or salt deserts, among which, according to the accounts of the natives, Tanezruft, lying on the route between Tuat and Timbuctoo, is the most remarkable in extent; and it may be a question whether a scientific exploration will not reveal the existence of the plateau formation at least in some portions also of this desert.

In regard to plants and animals, we find that the necessary

condition of their existence, viz: rain, is by no means so rare a phenomenon as our earlier accounts have led us to conclude. For, though Sahara may perhaps justly continue to be regarded as in the main a rainless belt, yet we find many exceptions in sudden and very copious showers, and it is altogether likely that there are many tracts, like the oasis of Air, which have their regular rainy seasons; for we find even in the northern Hamadah, scattered thickets and a few small birds.

Basle Missionary Society Atlas.—A new atlas, published by the Basle Missionary Society, although especially intended to illustrate the operations of that society, contains much geographical information not accessible in any other work. The maps which it contains are, 1, the World; 2, Africa; 3, Central West Africa; 4, the Southern Wolta District on the African Gold Coast; 5, India; 6, South Mahratta; 7, 8, North and South Kanara; 9, Malabar; 10, China; 11, Sinon District in China. Petermann commends particularly Nos. 4, 6, 7, 8, 9, and 11.

The English and American missionary stations, as well as the German, are distinctly noted. Prefaced to the atlas, is a table showing the present missionary stations of Protestant churches in Africa. It is interesting, not only in a philanthropic, but in a scientific point of view, to trace the distribution of these missions. Twenty-five societies (eight American) maintain stations.

Tobler's Planography of Jerusalem.—The work of Van de Velde on Palestine, is already well known. Its author has now compiled from the English Ordnance Survey and the measurements of Dr. Titus Tobler, a Plan of the Town and Environs of Jerusalem, which the latter illustrates by a special memoir. In this is contained a historical review of the various maps of Jerusalem and the surrounding country, which have been made since the twelfth century, with a critical examination of all that are modern. The plan constructed by Van de Velde, differs in various details from the maps which are commonly received, and bears strong claims to superior confidence. It is distinguished also by its fine execution.

Kotschy's Travels in the Cilician Taurus.—Dr. Theodore Kotschy, one of the keepers of the Imperial Botanical Cabinet in Vienna, has just published an interesting volume which lies before us, containing the results of his researches in the Cilician Taurus. It is introduced to the public by a preface from Dr. Carl Ritter, who speaks in emphatic terms of the valuable aid he has derived from the manuscript communications of Dr. Kotschy, in preparing a new volume of the *Erdkunde* (the second devoted to Asia Minor) which is about to appear from the press.

So little has been known in respect to this most interesting mountain land, and, indeed, in respect to the eastern part of Asia Minor, that the researches of Dr. Kotschy are both new

and important. He paid particular attention to the botany of the region which he visited, and now describes its marked peculiarities. The early part of the volume is an interesting account of his general observations while travelling, including a description of the city of Tarsus. An appendix of one hundred and twenty pages is devoted to scientific details, including papers on the climate, geology, botany and zoology. A long enumeration of the plants which were observed is made, including many which thus far have only been found in that locality. A lithographic sketch and a map are given of the Bulghar Dagh; and a table of the heights in the Cilician Taurus, of which the most elevated is Metdesis, 11,000 feet.

Exploration of Brazil.—The Emperor of Brazil has determined to send out a national scientific expedition for the exploration of the less known provinces of the empire. The party which was to leave Rio Janeiro early in the present year will be divided into five sections, botanical, mineralogical, zoological, ethnological and astronomical and geographical, each under a separate chief. All the members are Brazilians by birth. The head of the party is Francisco Freire Allemao, who is also chief of the Botanical section. The preliminary arrangements of the expedition give promise of important results.

Longitude of Valparaiso.—Recent telegraphic experiments between Santiago and Valparaiso have indicated the difference in time between Valparaiso and Paris to be only $4^h\ 55^m\ 49{\cdot}5^s$, the previously received difference having been $4^h\ 56^m\ 6{\cdot}6^s$. A large part of the coast of South America has accordingly been placed on the maps $17{\cdot}1^s$ in time, or $4'\ 16\frac{1}{2}''$ in arc too far to the west.

Death of Adolphe Schlagintweit.—In India, positive and it is feared authentic information has been received of the death of the explorer and naturalist, Adolphe Schlagintweit, one of the three brothers well known for their scientific researches, pursued under the auspices of the East India Company, in India and among the Himalayas. It appears (says the *Times* correspondent) that a party of Khokandpas, belonging to a tribe in revolt against the Chinese, came into the Yarkand territory in the spring, and drove the few Chinese troops in the villages in the town of Yarkand. In one of the villages near the town the Khokandpas found Schlagintweit residing; and, in the course of conversation, he asked them why they did not attack Yarkand itself, where the Chinese force was so small and they were so numerous. For some unexplained reason they were offended at this question. They retired and held a conversation; the result of which was, that they decided he must be a friend of the Chinese and wished to ensnare them; and in the dead of night, they surrounded his house and killed him, to the great regret of their chief, who has saved some of the unfortunate traveller's instruments.—*Athenæum, Sept.* 18. D. C. G.

Yale College Library, Oct. 9, 1858.

ART. XLIII.—*On Picric Acids and some of its Salts, with an Advantageous Modification of one of the Processes for obtaining it;* by M. CAREY LEA, of Philadelphia.

PICRIC or properly trinitrophenylic acid may be referred, according to the views of Gerhardt, to the type of water H_2O_2, in which one atom of hydrogen has been replaced by an atom of the hypothetical radical trinitrophenyl $C_{12}H_2X_3$. Pisani has succeeded in forming the chlorid of this radical and its amid, or ammonia in which one atom of hydrogen has been replaced by it.*

Picric acid, whether crystallized in thin laminæ from water, or in long prisms from alcohol, is, when pure, of a very pale yellow. Its alkaline salts when uncontaminated by foreign matters are of a perfectly pure yellow.

The color of these alkaline picrates varies very much with the specimens of acid with which they are made: the potash salt varies through every shade from yellow to yellowish-brown, or to chestnut with a golden glitter, and so with the ammonia salt. It is a little remarkable that picric acid when first obtained from new sources has been twice described as a new acid, the chrysolepic acid of Schunk and the picranisic of Cahours, in both cases apparently in consequence mainly of the difference in the appearance of the alkaline salts of the new acid from that of those formed with picric acid prepared in the usual way.

The chrysolepic acid of Schunk or picric acid formed by the very prolonged action of nitric acid on aloes, has a greenish shade, and forms a potash salt differing very much in appearance from ordinary picrate of potash. In place of being pure yellow it is chestnut-brown, and the play of colors, which with ordinary picrate of potash is red and green, is with it, purple and yellow. It appears to form larger needles than the ordinary salt, and is a very beautiful substance. A modification of picrate of potash much resembling it may be obtained by crystallizing the ordinary salt with the addition of a very small quantity of picramate of potash, an experiment readily made in the following manner; a small quantity of picric acid is introduced into a test tube, water added and a single drop of solution of protochlorid of tin, the whole is boiled, supersaturated with carbonate of potash, boiled again and filtered hot; picrate of potash will crystallize out, of a shade of red-brown depending in its color upon the amount of picric acid reduced by the protochlorid of tin, which latter must be employed in very small proportion. A similar experiment may be made with the ammonia salt, the pure yellow of which is converted to chestnut-brown by the addition

* Liebig. Ann., xcli, 326.

of a very small quantity of picramate, and to green by a larger one. The resemblance of the salts thus artificially colored to the picrates formed with the acid obtained from aloes is so striking that I was for a long time disposed to believe that the aloes-acid salts derived their color from the presence of picramic acid in extremely small quantity. But as picramic acid is readily oxydized into picric by the action of fuming nitric acid,* the aloes acid ought, by being boiled with fuming nitric acid, to be converted into ordinary picric acid, if the difference between them consisted only in the presence of picramic acid. But this reaction cannot be obtained, whereas the artificially colored salt above mentioned, by being boiled with a large excess of nitric acid and then supersaturated with carbonate of potash, crystallizes in its ordinary place without the slightest admixture of picramic acid. I have not found any process by which picrate of potash prepared from aloes can be brought to the color of the pure salt. By boiling with animal charcoal the red-brown becomes a dirty yellow, which is the nearest approach I have obtained to the normal color.

The picric acid first obtained by Cahours from trinitranisol,† and by him called picranisic acid, has been generally admitted by chemists (with the exception of Gerhardt) to be identical with picric acid, and not merely isomeric with it. It is only difficult to understand how this could ever have been doubted, whether, we look to the source of its formation or to its physical characters. Although the crude acid sometimes gives a dark colored potash salt, it more frequently at once yields a bright yellow one with all the marked characteristics of picrate of potash.

The process for obtaining picric acid from commercial creosote is an advantageous one. The acid obtained is readily purified and gives bright yellow alkaline salts.

A number of experiments were made on the old process of decomposing indigo with nitric acid with very various results, probably depending upon the great difference in the composition of commercial indigo. I have seen the ammonia salt crystallize out clear yellow, and from the mother water by spontaneous evaporation, a green picrate of ammonia deposited which exactly resembled that above described as obtained by the addition of minute quantities of picramite of ammonia. The indigo process is one of the least advantageous.

* Of this fact, though called in question by Gerhardt, [Chimie Organique, iii, 47,] there can, I think, be no doubt.

† In preparing trinitranisol, if the process ordinarily given for obtaining nitranisic acid be followed, a great portion of the product is lost. After acting upon oil of fennel for a sufficient length of time with nitric acid, we are directed to add water to throw down yellowish flocks which are the impure nitranisic acid. I have found that after the complete deposition of the yellow flocks, the mother water still contains the greater part of the nitranisic acid, and by standing for twenty-four hours deposits it.

It has been frequently stated that the picric acid obtained from salacine is so pure as not to require purification. Gerhardt, on the contrary, states that oxalic acid is also produced in the reaction, and I have found it so.

Dr. Stenhouse first pointed out that the yellow Australian gum resin obtained from the Xanthorrhæa hastilis was the most advantageous substance from which to obtain picric acid. This gum, which has not yet reached our markets, is easily procured in London. It varies very much in appearance, some specimens which I have received being very ligneous, others wholly free from woody fibre.

All the processes prescribed for obtaining picric acid from Australian gum, aloes, indigo, &c., (creosote excepted) are similar; they consist in treating the vegetable substance with six or eight times its weight of strong nitric acid in the cold. After the first strong action has ceased, more acid is added, heat is applied and continued for ten or twelve hours, adding acid to supply the place of that driven off. The process is unpleasant on account of the vast volumes of red nitrous fumes thrown off in the earlier stage, and wasteful, inasmuch as more than half the nitric acid used is driven off unaltered. By the following modification of the process, the amount of nitric acid necessary is reduced one-half, and the disengagement of fumes diminished in a still greater proportion. As all the violence of the action is done away with, the fumes may readily be carried off without inconvenience.

Into a flask capable of containing at least two or three quarts, five ounces of Australian gum is introduced in lumps, twelve ounces measure of nitric acid sp. gr. 1·42 or thereabouts, are poured over it, and as soon as the action commences, twenty-five ounces of water (hot is preferable but not essential), *which must be at hand ready measured*, as the action is very sudden, is introduced. A gentle heat is then applied; for about two hours the mass puffs up very much; and if there is danger of running over, cold water may be added, but as little as possible, and the necessity for using any should be avoided by a due regulation of the heat. By degrees the mass subsides, when the heat may be increased, and continued till the bulk of the mixture is reduced to one-half, or even less. Five more fluid ounces of the same acid are then to be added, and the heat continued till the fluid is reduced to where it was before the last addition, and even carried a little further. From four to seven more fluid ounces of nitric acid will be required to complete the operation. After this last addition, the heat is to be continued until the mixture is reduced to the bulk of four or five fluid ounces. After cooling this will be found to have become a cake of picric acid more or less solid in proportion to the point to which the final evaporation has been carried.

The whole of this operation may be carried on in the laboratory without a perceptible escape of acid vapor. A cork in the neck of the wide-mouthed flask with a long-necked funnel, and a bent glass tube sufficiently long to reach within a few inches of the bars of a grate or the air-draft of a stove, will effect this object. By inclining the tube and placing a vessel under its end, a large quantity of nitric acid may be collected, which may be cohobated, and serve to reduce the quantity of fresh acid employed, remembering, however, that it is very weak, having a specific gravity varying from 1·1 to 1·2.

This process might doubtless be extended to other materials, such as aloes, indigo, the refuse of gum bezoin after sublimation of benzoic acid, &c. It does not require more time than the ordinary process.

The purification of the crude picric acid is best effected as follows: The crude acid is well stirred up with a small quantity of water, which after rest, is decanted and the operation repeated. The acid thus washed is dissolved in boiling water, sulphuric acid added in the proportion of eight or ten drops to each pint of solution, which is boiled for a few minutes, and rapidly filtered through a heated filter. It is convenient to filter into a porcelain dish over a lamp. The picric acid is then neutralized with carbonate of potash, or preferably with solution of crystallized bicarbonate, as a troublesome second filtration is thus saved. When the potash salt crystallizes out it is to be thoroughly freed from the mother water and recrystallized. If desired to have a very pure product, it may be boiled with animal charcoal and recrystallized several times. The potash salt is decomposed in a boiling solution with chlorhydric acid, and the picric acid, when thoroughly freed from adhering chlorid of potassium, is pure.

In addition to the reducing agents already known to be capable of converting picric acid to picramic, the same effect may be produced by cyanid of potassium which in the presence of an alkali instantly decomposes picric acid, producing a solution intensely colored by picramic acid. Manganid-cyanid of potassium gives the same result with the aid of heat. By boiling the solution with the addition of fuming nitric acid, it is decolorized to pale yellow, the picramic acid having exchanged an atom of NH_2 for one of NO_4. This reaction affords an extremely delicate test for the presence of a cyanid.

Picrate of Baryta.—By slow evaporation yields prismatic crystals, which are dichromatic. In the evaporating basin they present the appearance of yellow prisms with red summits.

Picrate of Glucina.—Carbonate of glucina dissolves readily in a hot aqueous solution of picric acid, and by evaporation yields golden-yellow crystalline crusts. By heating on platinum foil it

becomes orange-red, boils up and burns with a feeble deflagration, leaving a sooty mark and a loose white ash.

Picrate of Alumina.—Hot solutions of chlorid of aluminum and picrate of ammonia, placed in a beaker glass and left for several days, give beautiful stellar aggregations of crystals which are permanent in the air, and by heating become slightly brown and then detonate. By recrystallization only crystalline crusts are obtained, which no longer detonate by heating, but only deflagrate with a smoky flame.

Picrate of Protoxyd of Manganese.—This beautiful salt, the most interesting of all the picrates, is easily formed by dissolving the protocarbonate of manganese in hot aqueous picric acid. By spontaneous evaporation large prisms belonging to the rhombic system are readily obtained. These prisms exhibits the faces $\infty \breve{P}\infty$, $\infty \bar{P}\infty$, with an intermediate prism face, and the terminal planes 0P. The face $\infty \breve{P}\infty$ is sometimes wanting, and no pyramidal faces were found in any of the very numerous specimens examined.

These crystals are distinctly dichromatic; examined by light transmitted through the prism parallel to its axis, they are of a clear pale yellow color; in any other position they are of a reddish-salmon, varying with the light. If a crystal be held with its prismatic axis vertical, and be viewed horizontally through a Nicols' prism, so placed that the principal section passing through the obtuse trihedral angles of the prism shall be in the same plane as the axis of the crystal, the image is of a fine salmon-red, varying with different specimens. If the same principal axis of the Nicols' prism be turned till it is at right angles to the axis of the crystal, the image becomes clear light amber-yellow.

The picrate of manganese does not appear to be capable of forming double salts with soda or ammonia. A crystal heated on platinum foil becomes deep red and then instantly deflagrates, so suddenly as to project portions which do not take fire.

Picrate of Protoxyd of Iron.—Isomorphous with the manganous and cadmic salts, crystallizing in large greenish-yellow prisms belonging to the rhombic system, and exhibiting the same faces as the manganous salt, viz.: $\infty \breve{P}\infty$, $\infty \bar{P}\infty$ with an intermediate prism face, and the terminal planes 0P. The face $\infty \bar{P}\infty$ is also in this, and the isomorphous cadmium salt, often wanting. It does not, however, appear to possess the dichromatic properties of the picrates of manganese and cadmium, and unless thoroughly protected from the air, peroxydizes gradually on the surface. Even in solution, however, it is sufficiently permanent to be crystallized by spontaneous evaporation in an open evaporating dish; the surface of the solution becomes indeed covered with a film of decomposed salt, but good crystals may be picked out from underneath.

Picrate of Peroxyd of Iron.—Picric acid in solution boiled with freshly precipitated and still moist peroxyd of iron takes up so little of the metal as to give but slight indications with sulphocyanid of potassium. By accurately precipitating picrate of baryta with persulphate of iron and leaving to crystallize by spontaneous evaporation, the perpicrate of iron is obtained in small yellowish red prisms and yellow needles, which, particularly when examined with a lens, exhibit a beautiful amethyst reflexion. Heated on platinum foil, it fuses to a red liquid which grows deeper and deeper in color until it takes fire and burns with a hissing noise.

Picrate of Cobalt.—The neutral salt is readily obtained by adding a somewhat concentrated solution of chlorid of cobalt to a similar one of picrate of soda. If the solutions be hot the salt crystallizes out by cooling. In this way beautiful amber-brown crystals may be obtained which often extend entirely across the evaporating dish, and which must be freed from adhering chlorid of sodium by recrystallization from a small quantity of hot water. This process is more easy and less wasteful than that recommended in the text-books, of digesting picric acid with carbonate of cobalt and separating the neutral from the basic salt by absolute alcohol. Heated on platinum foil, the picrate of cobalt melts, becoming reddish-black and deflagrates with a white light.

Picrate of Nickel.—Hydrated oxyd of nickel readily dissolves in hot aqueous picric acid, giving a yellow solution which yields green crystals by evaporation. By spontaneous evaporation beautiful prisms are obtained, sometimes an inch and a half or more in length. By heat it becomes first yellow, then brown, and finally deflagrates with a brilliant white light.

Ammonia Picrate of Nickel.—This beautiful but very unstable salt is formed whenever an ammoniacal solution of chlorid of nickel is mixed with a soluble picrate. I have generally used picrate of baryta for this purpose. An abundant and highly crystalline bright yellow precipitate takes place, which under the compound microscope is found to consist of bundles of transparent acicular crystals. Even cold water in sufficient quantity decomposes this salt. Placed on a filter and washed the water runs through bright yellow, and after a sufficient time the filter is found to contain nothing but hydrated oxyd of nickel, free from any trace of picric acid, converted partly into basic carbonate by exposure to the atmosphere. The wash water by evaporation yields, as might be expected, crystals of picrate of ammonia. It is, therefore, evident that the salt when precipitated must be washed with the smallest possible quantity of water. Nearly the whole of the picrate of ammonia may be washed out without changing the color of the precipitate, which becomes a bright yellow meal of hydrated oxyd of nickel colored by a trace of picrate, having

undergone no visible change except the loss of its crystalline structure. Heated on platinum foil, the ammonia picrate of nickel turns brown and deflagrates with a brilliant white light.

Picrate of Protoxyd of Chromium.—Chromous acetate dissolved in aqueous picric acid yields a brown solution which by spontaneous evaporation dries up to a crust which shows no trace of crystallization.

Picrate of Sesquioxyd of Chromium.—Basic carbonate of chromic oxyd boiled with aqueous picric acid gives a greenish solution which by spontaneous evaporation affords greenish crusts with no trace of crystallization. But by accurately precipitating the violet modification of sulphate of sesquioxyd of chromium with picrate of baryta, and leaving the filtrate to evaporate spontaneously, minute greenish needles are obtained.

Picrate of Zinc.—Carbonate of zinc readily dissolves in hot aqueous picric acid, and the salt crystallizes out in small prisms which effloresce even in well closed vessels.

Picrate of Cadmium.—Carbonate of cadmium dissolves readily in hot aqueous picric acid, and gives by spontaneous evaporation very beautiful crystals belonging to the rhombic system, and isomorphous with the manganese and iron salts, which it very closely resembles; it is, however, somewhat lighter in color than the manganese salt, and possesses its dichromatic properties in a much inferior degree. It is extremely soluble in water, and the crystals gradually effloresce even in well closed vessels. By continued boiling its aqueous solution deposits a brown powder, probably a basic salt.

Ammonia Picrate of Copper.—This salt bears great resemblance to the corresponding nickel salt. It is readily obtained by mixing a solution of sulphate of copper in ammonia with an alkaline picrate; an abundant precipitate falls, so bulky that if the solutions are somewhat concentrated the mixture becomes pasty. Like the nickel salt, it scarcely bears washing. Boiled with water, a solution of picrate of ammonia is obtained, and brown flakes of oxyd of copper deposited. A portion of the salt covered with a large quantity of water and occasionally stirred for a day or two is entirely decomposed, with deposition of blue flakes of hydrated oxyd of copper. The freshly precipitated salt examined under a good microscope appears highly crystalline. Its color is greenish-yellow with a faint reddish shade, and it has much the lustre and general appearance of the dust upon the wings of butterflies. Heated upon platinum foil, it deflagrates powerfully with a brilliant white light.

Picrate of Peroxyd of Mercury.—Carbonate of peroxyd of mercury dissolves by digestion in aqueous picric acid, and gives by evaporation brilliant orange-colored needles, easily soluble in water, and by exposure to air efflorescing to yellow. Heated it

reddens, melts, takes fire and burns with vivid combustion. The picrate of protoxyd of mercury is a greenish-yellow, very insoluble precipitate.

Picrate of Silver is but slightly soluble. Nitrate of silver poured into a solution of a soluble picrate, as picrate of magnesia causes at first no precipitate, but after a few minutes beautiful radiating clusters of needles form in all directions through the liquid.

Picrate of Urea.—This very beautiful combination is easily obtained by dissolving urea in solution of picric acid. It crystallizes in large fan-shaped aggregations of bright yellow needles, permanent in the air.

Picrate of Quinia.—Alkaline picrates added to solution of sulphate of quinia throw down a bright yellow powder, insoluble in water, but very soluble in alcohol. By spontaneous evaporation of the alcoholic solution in a beaker glass covered with filtering paper, small tufts of yellow needles are obtained. The statement of L. L. Bonaparte quoted in Gerhardt (Chemie Organique, iv, 123) I have not found confirmed. Heated on platinum foil, it burns quietly with a yellow flame.

ART. XLIV.—*On Deep Sea Explorations;* by Prof. W. P. TROWBRIDGE.

OUR present knowledge of the depth of the sea, in all quarters of the globe, may be compared to the ideas which existed in the minds of men, with regard to the form of the continent of America, after the first voyages of the old Spanish and English navigators. Previous to the discovery of Columbus, the most exaggerated notions were entertained of the boundless extent, the unfathomable depths, and the dark wastes of that great chaos of waters which no man had yet dared to explore.

The discovery of the great navigator, was quickly followed by the explorations of Ponce de Leon, Cabot, and others, who touched upon various points of the unknown land, and bore back to the old world trophies from the new. Many of the charts made by these bold mariners are still preserved as memorials of their achievements; but what a contrast do they present to the maps of the present day; in most of them, scarcely a resemblance can be traced to the form of the continent which we now inhabit. The world does not cease to honor these adventurous pilots, because their first efforts were not entirely successful: subsequent researches, with the help of continued improvements in the art of navigation, and in astronomical science, corrected their errors without detracting from their merits. But while these vague notions with regard to the superficial extent

of the sea have been removed, and its surface measured with all desirable accuracy, the veil of mystery still obscures its depths. The bottom has been reached at various points, and the world has just witnessed the wonderful stride in human progress, to which the first movements in this new field of scientific investigation have led. It is therefore legitimate, now, to review what has been done; not with a view of criticising the works of those who have been foremost in these discoveries, but with the better motive of seeking for truth and stimulating to renewed efforts those who have already done so much, by suggesting probable causes of error in the results which have been obtained; so that new methods may be devised, if necessary, for establishing with the certainty which science and the popular mind now require the true form of that portion of the solid crust of the earth, which lies concealed beneath the waters of the ocean.

The question of the character of the thin covering of the bottom, has undoubtedly been settled by the examination of specimens brought to the surface. And here we must digress somewhat to refer to the labors of those who were first instrumental in inaugurating deep sea explorations.

In the year 1845, Lieutenant (now Commander) Charles H. Davis, U. S. N., while running a line of deep-sea soundings across the Gulf Stream, under the direction of the Superintendent of the Coast Survey, obtained one cast of 1350 fathoms, and brought up a specimen of the bottom with the "specimen cup" of Lieut. H. S. Stellwagen, U. S. Navy. With regard to this sounding, Lieut. Davis remarked as follows: "U. S. Brig Washington, Oct. 29th, 1845. Sounded with 1300 fathoms line, ($1\frac{3}{4}$ miles,) and found bottom at that depth." "After the lead was felt to strike the bottom, the line became slack, so that the quartermaster could haul it in hand over hand." "It appeared to fall off again from the side of the bank, and took the remainder of the line, amounting to 1350 fathoms" (in all). "*The cup came up filled with a greenish mud, which is preserved.*" "At 3 P. M., sounded again with 715 fathoms line, and found the same bottom as before." The cup referred to, was the Stellwagen cup, which is used by some at the present day. In the explorations of Lieut. Davis, 95 specimens of the bottom, and 25 specimens of water at various depths, were brought up and preserved.* In the suc-

* See Reports of Superintendent of Coast Survey, for 1845, 1846, 1847, 1848.

The following interesting observations are cited from the Report for 1847, p. 25: "Collections of specimens of the bottom from soundings in this section, were first commenced by the late Lieutenant Commanding George M. Bache, United States Navy, and have been added to every year since 1844, placed in small bottles for easy inspection, and duly labelled. It was the intention of that lamented officer to have classified them during the past winter, and to have placed characteristic specimens upon an off-shore chart on a suitable scale, thus enabling the eye to generslize the results so as to reproduce them methodically arranged, as upon a geological map. In addition to this, the microscopic examination of these specimens could hardly fail

ceeding year, in the same explorations, soundings were made to the depth of 1500 and 2160 fathoms, without finding bottom; but in the latter case the temperature of the water was recorded at the depth named. In 1848, in the explorations off Cape Hatteras, the officer engaged in the explorations lost his instrument, with 3300 fathoms of line out.

These Gulf Stream explorations were undoubtedly the first systematic deep sea explorations ever undertaken.

Our principal object, however, is to notice those great depths where *no bottom was found*, and to examine whether the failure *to find the bottom* was, under the circumstances, any proof that it did not exist at much less depths than those reported, or whether any conclusion whatever can be derived from the results.

When we reflect that two-thirds of the earth's surface is covered with water, while the remaining third is dry land; and that the figure of the solid part can only be known when we can trace with certainty the mountain ranges and valleys along the bottom of the sea, it becomes important to scrutinize those reported measurements which give such enormous depressions in different parts of the sea, compared with which the highest mountain ranges are insignificant elevations. Numerous instances have been reported in which soundings have been made to the depth of five, six, seven, eight and nine miles without finding bottom; and again over large areas the bottom of the sea is represented as a comparatively level plain submerged to the depth of two, three or four miles. Supposing these reported measurements to have been correct, we would have, still, very insufficient data for arriving at any correct conclusions with regard to the elevations and depressions of the ocean bed. What idea could be formed, for instance, of the topography of our country, if our knowledge of its surface consisted in knowing the height, above the level of the sea, of only one point in every

to develop interesting facts in regard to them, some of which might prove of importance to navigators, as all would be to general science. Professor J. W. Bailey, of West Point, kindly commenced an examination of this sort. 'All the deep-sea soundings,' he says, (in a letter to me on this subject,) are of the highest interest, being filled with organisms, particularly the calcareous Polythalamia, to an amount that is really amazing—hundreds of millions existing in every cubic inch of these green muds.

"'The most interesting specimen is the one labelled No. 1, latitude 38° 04′ 40″, longitude 73° 56′ 47″, 90 fathoms. This is crowded with Polythalamian forms, *mostly large enough to be recognized by a practised eye without the aid of a magnifier.*' A figure, or specimen which would enable a practised eye to recognize these forms—and Professor Bailey has promised to illustrate these researches by drawings—would render even this first inspection of practical value; the 'large Textularia, having the form of a *truncated pyramid*, which characterizes No. 8, latitude 39° 31′, longitude 72° 11′ 20″, 89 fathoms, not being mistakable for the forms abundant in No. 1,' it is to be hoped that Professor Bailey will carry so promising a subject to a conclusion. He may add another to the aids furnished by sceince to navigation."

State of the Union. Such points, selected at random, might be the highest or lowest points within an area of some thousands of square miles; and after all, we would only know that it was possible to measure those heights, without being able to conjecture, even, their relation to each other. In the case of deep-sea soundings, we only know that bottom has been reached; in some instances at depths which show that our ideas concerning the unfathomable abysses of the ocean have been erroneous, and to sustain the belief that the mean depth is less than has been supposed. With regard to the uncertainties of the measurements, it is not sufficient to say that, compared with the immense area over which they are spread, the depths are very small; it might as well be argued that the height of the Alps is insignificant compared with the distance around the earth, and therefore an error in height of one or two miles is unimportant: or that the elevations of ordinary mountain ranges need not be noticed when compared with the area of a continent. We are dealing with finite quantities not with the infinite with which they may be compared; and an error of several thousand feet in two or three miles is hardly within the limits of scientific accuracy.

Prominent among the instances of these reported unfathomable depths, stands the sounding of Captain Denham of the British Navy, in H. M. S. Herald, made in October, 1852, on a voyage from Rio de Janeiro to the Cape of Good Hope. This is an extreme case, but since it is reported among the greatest deep-sea casts, it will serve best for illustration.* *All other great casts of the lead which have been reported are subject to the same causes of error*, which are to be found in this, some in a greater and some in a less degree; so that it is not necessary for us to believe, yet, any thing with regard to them, except that they gave no result. The sounding of Captain Denham was made with a lead weighing nine pounds, attached to a line one-tenth of an inch in diameter; and it is reported that this lead descended to the depth of nearly nine miles in the sea without touching bottom.

In accordance with a plan which originated with the lamented G. M. Bache, United States Navy, in 1846, in the explorations of the Gulf Stream, and which has constantly been followed since Captain Denham noted the time of running out of the successive portions of the sounding line during the nine hours of its supposed descent. According to these observed times of descent the nine pound lead communicated to the descending line at the depth of 3,000 fathoms or 18,000 feet a velocity of *two feet* per second; a result which is *philosophically impossible*, since the re-

* Lieut. Maury discusses these deep casts in his sailing directions, but his rules for arriving at the depth do not seem to me to be entirely satisfactory.

sistance of the water acting upon a line of this diameter, moving with a velocity of two feet per second, at the depth mentioned, amounts to more than three times the weight of the lead or shot used. It will hardly be necessary to enter into any argument to show that there can be no motion of descent, when the resistance to that motion is three times the weight of the moving mass. Further, the observations show that the nine pound shot and line were running with a velocity of two feet and a half per second at the depth of 2,000 fathoms or 12,000 feet. Here the result contradicts in quite as strong a manner the mechanical laws of the descent; and in fact below 1000 fathoms or 6000 feet, if we credit the observations, a velocity was observed in the running out of the line which it was impossible for the lead to communicate to it. In fact but a small part of that velocity could have been produced by the descent of the lead. Here we have a reliable result to the depth of 1,000 fathoms only. The difference between this result and the conclusions of Captain Denham is simply the difference between *one mile* and *nine miles*.

In measuring the distance to the sun an error of eight miles would hardly be worth noticing, perhaps, but what conclusions can be drawn from a measurement in which the probable error amounts to eight times the whole distance?

Popular ideas with regard to the sinking of bodies in the sea, have heretofore been vague; for the reason, perhaps, that the laws which govern this descent, and which are derived from the well known laws of fluids, have never been fully defined in their application to the depths of the ocean. Some imagine that ships which founder at sea, sink to a certain depth, and there float about until broken to pieces, or thrown upon some bank beneath the sea; and, indeed, a recent writer in England has published a book sustaining this absurd notion. Others again believe that the buoyant force of the water at great depths is enormous, and due to the whole pressure of the column of water above, and that all bodies which are lighter than water at the surface, will, if sunk to the bottom and detached from the sinker, shoot upward with a great velocity; or, in other words, that the *density* of the water increases directly with the depth. These views are erroneous. It is true the pressure increases with the depth, to the amount of fifteen pounds upon every square inch, for every thirty-four feet in depth; but the density is not thereby sensibly increased, owing to the incompressibility of the water; so that neither the buoyant force, nor the resistance to the motion of any body, are sensibly increased from the surface to the bottom. At the depth of 3000 fathoms, for instance, the pressure upon a square inch is nearly 8000 pounds, but the column of 18000 feet of water, is only shortened about 60 feet; the density is thus but slightly increased; but the effect of this enormous

pressure upon compressible bodies, as air, wood, &c., is to condense them into a smaller bulk, by which they may be rendered *heavier than water*, and will sink of their own weight. A piece of wood cannot float at the bottom of the sea, but a very slight extraneous force will bring it to the surface.

Now, how is it with the sounding lead and line? The lead, if allowed to descend alone, will fall with a uniform and rapid velocity to the bottom. This velocity will be attained within a few feet of the surface, and will be due to the opposing forces of gravity and the resistance of the water, which will be balanced, when the uniform velocity is reached. But if a line be attached to the lead, a few hundred feet of the line will offer a resistance to the motion nearly equal to the whole weight of the lead, and as successive lengths of line are drawn into the water, the resistance is constantly increased; so that at 2000 or 3000 fathoms depth, the weight will be almost entirely suspended in the sea by the resistance of the water along the sides of the line.

Some idea of the resistance which opposes the motion of a sounding line, may be formed from the fact that upon 1000 fathoms of a line one-tenth of an inch in diameter, moving with a velocity of three feet per second, the resistance is between twenty-five and thirty pounds. And if the velocity be increased to six feet per second, the resistance upon the line becomes an hundred pounds, nearly. Or, if the length of the line be doubled, with the same velocity, the resistance is doubled; and it is also directly proportional to the diameter of the line.

These are some of the reasons why an improvement in the mode of measuring the depths of the sea, is not only desirable, but necessary, before a certain knowledge of those depths can be obtained.

ART. XLV.—*Application of Polarized Light to the Microscope;* by DR. M. C. WHITE.

FOR conducting microscopic investigations with polarized light, it is customary to employ two Nicol's prisms, one of which is placed below the stage of the microscope, and the other just above the object-glass. If the prism placed below the stage is large a fine illumination is obtained by light reflected from a concave mirror placed below the prism, or by condensing the light, after it passes the prism, by means of an achromatic condenser. But as the Nichol's prism transmits only the extraordinary ray, produced by double refraction of the Iceland spar of which it is composed, one-half the light is lost and a powerful light is required to give adequate illumination.

The Nicol's prism above the object-glass, used for an analyser, requires to be large, otherwise the lateral portions of each pencil of light are cut off, the object seen in the microscope appears insufficiently illuminated, and the definition becomes very imperfect.

On the other hand, if the Nicol's prism is very large its length is increased in the same proportion as the breadth, and considerable aberration is produced by transmitting the pencil of light through so great a thickness of Iceland spar. A lateral displacement takes place equal to about one twelfth of the length of the Nicol's prism through which the light is transmitted.

These errors may be corrected and the definition of delicate objects greatly improved by placing another prism, exactly like the first, above it in the body of the microscope below the eye-piece, with its plane of principal section rotated 180°. This corrects entirely the lateral displacement. The second prism in the body of the microscope may be simply a prism of Iceland spar of the same dimensions as the Nicol's prism used as an analyser. This prism of Iceland spar may be placed next above the object-glass, and the Nicol's prism, if sufficiently large, just below the eye-piece without altering the effect. To show the *important* value of this *compensating prism* in the body of the Microscope, I will describe the results obtained with this apparatus.

With J. & W. Grunow's microscope No. 4, and a polarizing prism two and three-tenths of an inch in thickness beneath the stage, mounted to be used either with or without an achromatic condenser, I placed in the body of the microscope above the object-glass a Nicol's prism for an analyser, measuring two and one-fifth inches in thickness, and a prism of Iceland spar of the same dimensions (obtained from Rossie, N. Y.) in a reversed position just below the eye-piece. With this arrangement, using an eighth inch objective made by J. & W. Grunow, I was able to see three sets of lines on the Navicula angulata clearly defined, and with a good light, I could also distinctly see the six sides of the little hexagons on the same specimens. These phenomena can be seen with either of the three eye-pieces belonging to the microscope, but the six sides of the hexagons are best seen with No. 2 or No. 3 eye-piece. Taking away the compensating prism of plain Iceland spar, and with the same arrangement in every other respect, at the utmost only two sets of lines were seen, and the hexagons appear only as black dots, the form of which could not be distinguished. These facts prove conclusively, as I think, the great value of the compensating prism here described, which has never before been applied to the microscope so far as my knowledge extends.

New Haven, Oct. 1, 1858.

ART. XLVI.—*Correspondence of M. Jerome Nicklès, dated Paris, August 29th*, 1858.

Biographical Notices.—On the records of the same year, appears the death in France of two men of the same name, both of the great class of unfortunate inventors, and victims of their scientific zeal and devotion:—one, LOUIS FREDERIC SAUVAGE, the inventor of the screw used in navigation; the other, ALEXIS SAUVAGE, inventor of the method of supplying steamboats with pure water by continued distillation. Although one in name, there was no family relation between them.

Frederic Sauvage was born in Boulogne sur Mer, September 19, 1785. He was at first employed in the department of military engineering. In 1811, he became naval constructor; and a fact is mentioned of him, that attests to his probity in his profession. A French Company engaged him to construct steamboats to run between Boulogne and London. After examining the plans, and finding that they were faulty, Sauvage made some statements that were not well received. Notwithstanding the great remuneration which the work promised, he took his discharge from the company, unable, he said, to undertake to construct vessels that could not be navigated without endangering the lives of those aboard.

With principles so strict, it was difficult for Sauvage to succeed, and in fact, he had soon to give up his profession.

In 1821, he made arrangements at the quarry of Ellingen, for sawing and polishing marble by means of a horizontal mill of his own construction. About the same time he invented the *Physionometer*, a machine which afforded the statuary an easy and accurate means of taking moulds of objects in relief, and then obtaining an exact reproduction of the original. The machine afterwards applied by two speculators, under the name of the Physionotype, became to them a fortune; but to the inventor a source of disappointment and chagrin.

In the midst of these disappointments, Sauvage took up the problem of the use of the screw in navigation, demonstrated its feasibility by means of a small model, and worked out its proportions and the best position for applying it. But all this was insufficient to bring it into favor; as usual, it was also demanded of the inventor, after all his sacrifices, to make a trial on a large scale. Sauvage for ten years contended against the indifference of the government and the public. His propeller, finally, after being rejected in France, was adopted in England. It was now thought that the day of reparation had come. He was in prison for debts incurred in perfecting his invention, when the news reached him of the launching of the first French screw-propeller. An arrangement of the screw had been employed different from the plan of the inventor, and it worked poorly; it was however afterwards perfected. But by this time the patent of Sauvage had become public property, and he received nothing.

Enfeebled by his sufferings, and discouraged by so much injustice, the poor inventor lost his reason. He died at an Insane Retreat, in July of 1857, after a confinement there of twelve years.

Two inventions, due to F. Sauvage, are still in use. The first, dating from 1836, is the *Reducer*, a kind of pantograph for the sculptor, em-

ployed for reducing work in high relief. This valuable instrument has been the means of furnishing, at small cost, multitudes of copies of the best works in statuary. This process, still employed by Mr. Henry Sauvage, the son of the inventor, is now used at the Louvre, and ought soon to supply all the academies and schools with a collection of fine models.

The *hydraulic bellows*, by which water may be raised to a height determined by the weight of the column of water, was the last invention of Frederic Sauvage. This machine is applicable to a multitude of uses, and may replace with economy the pumps used for irrigation and fire-engines.

As observed above, the life of Alexis Sauvage was much like that of Frederic, and before speaking of his works, we may relate briefly his history.

Alexis Sauvage was born in 1781, near Paris, of parents who were common laborers. Without home resources, he had only his skill and his knowledge to rely upon. By ardent application, he rapidly familiarized himself with mechanical science; and his example may be an encouragement to the young without means, showing what may be accomplished by perseverance and study.

Alexis Sauvage entered as apprentice at Bellevue, in the manufactory of the locksmith, Gamin, who gave lessons, as is known, to Louis XVI. Becoming well versed in his profession, he was afterwards employed as a mechanic in the government workshops.

In 1816, when illumination by gas was introduced into Paris, Sauvage, after taking an active part in the operations which decided the adoption of this mode of lighting, brought into use a method of illuminating panoramas. The government of Louis XVIII. having taken this invention under its own control, a company was formed in 1822 under the auspices of the King, with the aid of Chaptal and other scientific notabilities. Sauvage was made superintendent of the illumination of Paris and the royal theatres. In this position, he rendered very great service to the new industry. To him, we owe the first method of controlling the distribution and consumption of gas, and in particular the registration of the burners, and the application on a large scale of gas metres.

Among the inventions of Mr. Sauvage connected with this subject, are, the porcelain tubes, called gas candles, a mode of imitating the sunlight by means of gas in the scenery of the theatre, and the arrangement for lowering or raising the light in public halls.

After 1830, the union of the French and English Gas Companies led to a sad change in the position of Alexis Sauvage, for he was deprived of his place as Superintendent of the Paris works. He then applied himself to other departments of the industrial arts. He took up the manufacture of beet sugar, and invented that magnificent apparatus, (Sauvage's apparatus) for evaporating the saccharine juices in a vacuum. He was also the first who undertook in France, and successfully, the construction of the steam-heating apparatus; and who conceived and executed the Telescope Gasometer, and mounted them in many gas works.

But the scientific and industrial subject which most engaged his thoughts, was the continued supply of water to steam boilers by using the water distilled in the action of the engine. The problem occupied

him till his death, and he had the happiness of success on a small scale. The method now waits only to be established in confidence by a trial in the large way.

During his life of labor, filled with privations and mortifications, Alexis Sauvage met with a severe accident. In 1849, he was badly injured by the explosion of the Telescope Gasometer at the Opera. In the midst of the general fright, he did not hesitate to face the flames, and, at the peril of his life, go and close the valves of the gasometer; he thus saved from immediate destruction a quarter of Paris, as also the whole equipment of the theatre. The horrible burns he then got led him prematurely to the grave. And how did the English Gas Company manifest their gratitude towards one rendered infirm in their service? Did it not at least assure him of bread for the rest of his life? They ordered him a bronze medal and let him go to the hospital.

Incapable of work, and failing to obtain justice, Mr. Sauvage applied to the courts; and it was not until six years had passed, in 1855, that the English Company was condemned to pay a pension for his support of 1200 francs.

After this great disaster by fire, Alexis Sauvage never recovered his health; but he still held firm to hope and his moral energy. A medal of the second class was given him by the Jury at the "Exposition Universelle," in 1855; and efforts were made to secure him the means of carrying out, on a large scale, his system of condensation. But the unhappy inventor was not permitted to see it accomplished. His old wounds reopened, and he died of gangrene.

In deference to the last wish of A. Sauvage, his son and some of his friends have taken it upon them to give to humanity the benefit of the important modification of the steam engine invented by him. An engine of this kind, of ten-horse power, is now constructing at Paris. No other interest but that of the public good, actuates those engaged in it, as the invention of Sauvage long since became public property. We take this opportunity of giving some account of his plan.

Feeding of Steam Boilers with a continued supply of pure water.—The inconveniences due to supplying steam boilers with common water, constantly renewed, are well known, in the thick incrustations which cause the burning of the iron shell of the boiler, the waste of fuel, and the larger number of explosions. In marine boilers, all these inconveniences are experienced with greatly increased force. The invention of Alexis Sauvage, is designed to avoid these evils, by feeding the boiler solely with pure water. Watt's plan for this purpose, engaged the attention of Mr. S. Hall, a builder of engines in England, who in vain endeavored to supply distilled water from the exhausted steam. Sauvage has been more fortunate in his efforts to secure the same end, and by the use of the apparatus he has invented, he not only secures the continuous feeding of the boiler with pure water, but he has also been able to dispense with the air-pump in the condensing engine, and in the high pressure engine to obtain a considerable increase of power. It would be difficult to give the details of the condensing apparatus here, but we may be able from the plans before us to convey a general idea of the system. The condensing apparatus consists essentially, for station-

ary engines, of a series of parallel straight tubes, surrounded by cold water on their outside to determine the liquefaction of the vapor; and the heat given up to the condensing water is also availed of in part in feeding the boiler.

In steamboats, the condensation acts in a still more simple manner. Four openings are provided in the hull of the ship on each side of the keel, two forward and two aft, covered and connected respectively by large copper tubes, open at the ends to allow the free circulation of water, when the vessel is in motion. These openings are controlled by large stopcocks. If within these large tubes, one or more condensing tubes are extended, the liquefaction of the steam is effected freely, and without the need of any mechanism, or the consumption of any power. The system of Alexis Sauvage, for feeding steam boilers with condensed vapor, claims the following advantages:

1st, An increase of power in all engines, and especially in high pressure engines.

2d, A simplification of the condensing engine.

3d, Diminished consumption of fuel, due, (1) to the use of water at 35° to 40° C. (=95° to 104° F.); (2) to the absence of solid or muddy incrustations in the boiler; (3) to the absence of foam or spray in the steam from pure water, giving dry steam, or steam free from water mechanically suspended, (4) to the absence of any necessity for stopping to clean out the boiler.

4th, The preservation of the boiler from the injuries resulting from the mechanical operation of removing the deposits, and above all, from all danger of bruising the iron.

[It is but just to an ingenious American inventor, Mr. Stephen A. Gold, to say that he many years since constructed a steamboat for ocean navigation, in which the condensation of the steam was effected in a hollow metal keel, with perfect success.—Eds.]

Electric Telegraph.—The Academy of Sciences has recently had under discussion the question whether the passage of an electric wire near a magazine of powder, would be a source of danger. It was referred to a Commission, who have reported as follows:

The Commission consider it certain that the currents used for telegraphing along the wires, can never cause accident. For if broken by the wind, or otherwise, the small spark that might be produced would not even kindle the floating dust deposited on the wire or their supports. But it is different with atmospheric electricity, which may be of great power, and serious in its consequences, if a powder magazine were near by. A stroke of lightning might fuse the wire for some length, and throw the melted globules to a considerable distance, and farther still, with the aid of the wind. Besides, the inflamed ends of the wire could not fail to describe a large area, and carry far the fire.

For security, the Commission propose,

1st, To substitute subterranean wires for the aerial, whenever it runs within a hundred yards of a powder magazine.

2d, To put subterranean wires far enough from the magazine to render it safe for workmen to construct them or to examine and repair them.

3d, To set up several lightning rods on poles 15 to 20 yards high, in the vicinity of these subterranean wires, in order to protect from the direct action of lightning.

Photography—Sensitiveness of Photographic Reagents.—The sensitiveness of the reagents used in photography, is well known. But there are others more sensitive still, which often interfere with photographic results. Photographers are aware that they do not succeed well in the vicinity of a perfumery, and that even the effluvia from the hand that has been wet with an essence, will prevent success when it was thought to be sure. It has even been supposed that in clear weather, when the atmosphere was full of vegetable emanations and vapors drawn from the soil by heat, photographs do not succeed as well, and that these influences must be avoided for the finest results. Evidently, the emanations from the soil and plants are themselves sensitive to the chemical rays, and more so than the photographic reagents, especially chlorid of silver, and hence as far as they are not destroyed, may monopolize the chemical action.

These thoughts are suggested by a fact recently made known by Mr. Ford. He had always had perfect success; but afterwards, in spite of all precaution, failed of good pictures. After long seeking the cause, he finally found that it was owing to his room being near a storehouse of "noir animal," for economical uses,—the effluvia was injurious to the photographic liquids, the principal of which were nitrate of silver, pyrogallic acid, and hyposulphite of soda. He moved to another place and had no more difficulty.

New Photographic process for the Printing of positive proofs.—A piece of sulphur is dissolved in sulphuret of carbon, in the proportions of twenty-five parts of the former to seventy-five of the latter, and the solution is then filtered. The solution in sufficient quantity is poured on the paper, which is shaken quickly in every direction, in order that it may spread equally, and crystals of opaque sulphur may not form. The paper thus prepared, is kept in the dark. At the required moment, the paper is put under an ordinary negative, and exposed to the light for twenty-five seconds to a minute, or five minutes on a dark day. When taken out, nothing is seen on the paper.

Nothing appears upon the surface of the paper when it is removed from the slide. It is then put over a mercury bath at the bottom of which are placed some grams of this metal. The sulphurized paper from the camera is then exposed at the distance of eight centimetres above the mercury, (which is heated meantime,) sustained on a frame of paper forming a cover to the bath, on the under side of which, with its face to the mercury, is the prepared paper. The vapor of mercury, combines with the portions of sulphur which have received the influence of the sun's rays, forming a yellowish brown sulphuret of mercury, which perfectly reproduces the details of the impression. The picture is then protected by a film of varnish-gum, or albumen, to preserve it.

This is the process of M. Salmon, of Chartres.

False Diamond.—In 1857, several men of science at Paris, were consulted respecting a stone of fine water, cut like the regent diamond, which had been offered to dealers as a diamond. Its characteristics proved it to be a topaz. The owner of it afterwards carried it to Vienna, where, according to a letter from Mr. Haidinger, it was also shown to be a topaz, both by its double refraction, hardness, etc. The owner had

asked some millions for his gem, and jewellers offered him but 250 francs, regarding it only as a matter of curiosity. It is to be hoped that it will not come again into market as a diamond.

Silk-Worms.—One of the most active and distinguished of the members of the society of acclimation, M. Guérin Mèneville, who has been especially interested in the introduction of new silk-worms, has just succeeded in acclimating in France a new silk-worm from China, where it lives in the varnish tree (*Aylanthus glandulosa*). The species is the true *Bombyx Cynthia* of Drury, (1773,) figured for the first time by Daubenton, Jr., in his colored plates which were published between 1760 and 1765, and raised for some centuries in China, where its silk clothes the people. Roxburgh, in 1804, supposed the *Eria* which is raised in British India, to be the same, and this confusion has continued till recently, so that the Eria, (or Arrindy-arria, as it is called in Hindoostan,) has gone by the name of *Bombyx Cynthia*. The Eria is a different species living on the Ricinus; and we have several times spoken of it.

The study of the species by Guérin Mèneville, has brought to light differences between the two in the cocoons and the habits of the worms. The cocoons carded give an excellent flock of silk which is used in China and Bengal for very firm tissues. The color of the silk is a fine flax gray; and cloths made of it are not injured by the rain, or oil, and wear long.

Now that the introduction of the silk-worm is accomplished, attention is turned to the extension of it industrially. Guérin Mèneville proposes for this end the making of plantations of Aylanthus, a tree that grows easily on poor soil; then to place the worms upon them in spring that were hatched in the month of May, and let them eat the leaves. Care should be taken to preserve them from the birds, which is easily done by an invalid workman incapable of other work, as has been the custom for centuries in China. At the end of June, the first crop may be gathered, and a second in August. The cocoons for reproduction should be preserved until the next May, which requires, as with the silk-worm of the Ricinus, and the Dipsacus Fullonum, special care in the winter.

Bibliography.

At HATCHETTE'S, *Rue Pierre Sarazin, Paris:*

E. DeWarren, *L'Inde Anglaise avant et apres l'insurrection de* 1857. 3d edition, 2 vols, in 12mo; 1858.—Mr. DeWarren has been in the service of the East India Company for twenty years, and speaks from actual sight. The first edition appeared twelve years since. The record of recent events have given it a new interest.

Blaise Pascal: *Oeuvres Complètes.* 2 vols, 12mo; 1858.—Blaise Pascal, the great philosopher, the great theologian, who at the age of thirty-three, made in mechanics and physics inventions enough to immortalize any man, died in 1657, at the age of thirty-nine. This edition is a republication of his works, both philosophical and scientific. The latter are found in the second volume, and include, besides others, Experiments on the Vacuum, Treatise on the Equilibrium of Liquids, Treatise on the Weight of Air, Arithmetical Machine, Treatise on Numerical Orders, Problems on the Cycloid, History of the Roulette, Treatise on the Arcs of Circles, etc.

CORTAMBERT: *Cours de Géographie.* 2d edition; 1857.—Mr. Cortambert is eminent in France, as an instructor in Geography; and his works have corresponding success. The first edition appeared two years since.

At BAILLIÈRE'S, *Paris:*

M. LECOQ: *Etudes sur la Géographie botanique de l'Europe et en particulier sur la végétation du plateau central de France.* T. ix, 1858; Paris.—The printing of this work began in 1854, and the last volume has just appeared. Thirty years of study and observation in Auvergne, are discussed from a geological and botanical point of view.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On telescopes of silvered glass and mirrors with ellipsoidal and paraboloidal surfaces.*—FOUCAULT has communicated to the Academy of Sciences a memoir on the substitution of silvered glass for metallic alloys in the construction of reflecting telescopes, and on the possibility of producing surfaces of revolution which reflect parallel rays to a single focus. It may be reasonably doubted whether the author has gone beyond or even attained the results of Lassell, the Earl of Rosse, Nasmyth, and other English mechanical artists who have devoted themselves to this subject, but we shall, nevertheless, give his statements as we find them. Foucault, in the first place, remarks that the spherical surface itself is difficult to obtain with absolute accuracy. When a luminous point is placed in the centre of curvature of a concave mirror, the image of this point is usually surrounded by an aureole, the appearance of which indicates defects in the surface. The author remedies these defects by retouching the mirror in different parts until the image is free from faults. The spherical mirror is then converted into an ellipsoidal and finally into a paraboloidal mirror by successive processes of approximation. A luminous point placed at first in the centre of curvature is made gradually to approach the principal focus; the image of course recedes in the opposite direction. By means of an appropriate polisher, the figure of the mirror is corrected for each successive portion of the luminous point, until finally the aberration becomes invisible for parallel rays. A telescope constructed in this manner with a mirror 33 centimeters in diameter, and having a focal length of $2^{m}{\cdot}25$ the author succeeded in resolving the blue star of γ Andromedæ into two distinct points. This result had hitherto been obtained only by Struve with the large Pulkowa instrument.—*Comptes Rendus*, xlvii, 205.

2. *On the influence of temperature upon phosphorescence.*—E. BECQUEREL has found that the color of the light emitted by phosphorescent bodies depends upon the temperature. Thus sulphid of strontium obtained by the action of sulphur upon caustic strontia at 700° C. or 800° C. is luminous with a violet light at ordinary temperatures, but changes its tints when the temperature varies, and returns again to its original tint when the original temperature is restored. In the case of sulphid of strontium the colors diminish in refrangibility as the temperature rises, but the re-

verse is the case with some other substances. The different effects depend upon the particular molecular condition of each substance.—*Comptes Rendus*, xlvii, 105.

3. *Distinction and separation of arsenic from antimony and zinc.*—Bunsen finds that oxyd of antimony is most readily distinguished from antimonic acid and antimonate of antimony ($2SbO_4 = SbO_3 + SbO_5$) even after strong ignition by gentle heating with chlorhydric acid after addition of a little iodid of potassium. Under these circumstances oxyd of antimony is dissolved to a yellow liquid without separation of iodine; in the other two cases iodine is set free and remains dissolved in the iodid of potassium. Even when the quantity of antimonic acid does not exceed some hundredths of a milligramme the solution gives a violet-blue or amethyst-red color when shaken with a few drops of bisulphid of carbon. The arsenic and antimony spots obtained in Marsh's process are easily distinguished by the following method. The spot is to be treated with enough nitric acid of density 1·42 to moisten it, and then gently heated till it vanishes. The porcelain plate is to be gently heated over a lamp while the operator blows strongly upon the moistened spot until the acid is completely evaporated without boiling. A drop of the ammonia-nitrate of silver will now produce a dark spot of suboxyd of silver if the white tache contains antimony. When, however, arsenic is present, the well-known yellow or brown-red precipitate is obtained, according to the duration of the action of the nitric acid, which may produce either arsenous or arsenic acid. In estimating antimony qualitatively Bunsen converts the precipitated sulphid into Sb_2O_5 by heating it in a porcelain crucible with a concave cover with fuming nitric acid. The boiling point of this acid is 86°, and therefore lower than the melting point of sulphur. The sulphur of the sulphid is therefore separated as a fine powder, and oxydizes easily and completely when the acid is evaporated in a water bath. The white residual mass gives on ignition pure Sb_2O_5. As the sulphid of antimony often ignites with fuming nitric acid, it may be previously moistened with acid of density of 1·42. Another method consists in igniting the sulphid of antimony with 30–40 times its weight of oxyd of mercury in a porcelain crucible, or better, in a platinum crucible lined with glass. For the precautions to be taken in using this method we would refer to the original memoir. Bunsen finds that bisulphite of potash dissolves sulphid of arsenic, but not the sulphids of tin and antimony. To separate arsenic from the other two metals he recommends adding a large excess of an aqueous solution of sulphurous acid to the solution of the three sulphids in sulphid of potassium. The liquid is to be digested in a water-bath, and then boiled until two-thirds of the water and all the sulphurous acid is driven off. The filtrate now contains all the arsenic as arsenous acid, while the mass on the filter is entirely free from arsenic.—*Ann. de Chemie und Pharm.*, cvi, 1.

4. *On the separation of alumina from iron.*—Chancel has observed that when a solution of hyposulphite of soda is added to one of a persalt of iron, the whole of the iron is reduced to the form of protoxyd, and remains in solution in the form of a double hyposulphite of soda and iron. On the other hand, weak bases, such as alumina and sesquioxyd of chromium, form extremely unstable compounds with hyposulphurous acid.

When hyposulphite of soda is added to a solution of alum as nearly neutral as possible, no precipitate is produced, but on heating to 60° C. or 70° C., sulphurous acid is disengaged, and alumina mixed with free sulphur precipitated, the reaction being expressed by the equation

$$Al_2O_3, 3SO_3 + 3(Na\,O, S_2O_2) = Al_2O_3 + 3S + 3SO_2 + 3(Na\,O, SO_3).$$

To render the precipitation complete, the solution containing the alumina must be very dilute, and must be boiled to expel sulphurous acid. For the separation of iron and alumina the author recommends the following process. The sulphuric or chlorhydric solution of alumina and iron is to be saturated with carbonate of soda until very nearly neutral, and water added till the liquid contains not more than 1 decigramme of alumina in 50 cubic centimeters. To this solution, which must be cold, a slight excess of hyposulphite of soda is to be added, and the whole allowed to stand until the liquid becomes completely decolorized. The liquid is then to be boiled until sulphurous acid is no longer disengaged. The precipitate of alumina and sulphur is to be filtered and washed with boiling water. The alumina is not gelatinous, but very compact, and may be washed with great ease. The ignition must, of course, take place in a porcelain crucible; the alumina obtained is perfectly white. The filtrate from the alumina contains all the iron. It is to be evaporated and treated with excess of chlorhydric acid and with chlorate of potash, diluted with water, filtered from the separated sulphur, and the iron precipitated by ammonia. The author asserts that the separation is exact in all cases.—*Comptes Rendus*, xlvi, 987.

[Note.—It would doubtless be much simpler to pass chlorine gas through the solution containing the iron after the separation of the alumina. The hyposulphurous acid would be thus directly converted into sulphuric acid, and the iron peroxydized.—w. g.]

5. *On the preparation of Calcium.*—Liès Bodart and Gobin have communicated to the Academy of Sciences a note on the preparation of calcium which is of much interest. The author found it impossible to obtain the metal by the action of sodium upon chlorid of calcium at a high temperature, but the reduction succeeds extremely well when the iodid is employed instead of the chlorid. The iodid of calcium was obtained by the action of iodhydric acid upon white marble, evaporating the solution and fusing the salt out of contact of air; as thus prepared it resembles chlorid of magnesium. Equal equivalents of sodium and iodid of calcium are to be mixed and gradually heated in a covered iron crucible to a strong red but not to a white-red heat. After an hour the crucible is to be removed from the fire and allowed to cool. In this manner the author obtained a button of calcium weighing about three grammes by employing four grammes of sodium. The metal was pale yellow with a reddish reflection, and proved on analyses to be pure. The authors promise more ample details with respect to the properties of calcium, as well as a notice of their results in reducing barium and strontium by a similar process.—*Comptes Rendus*, xlvii, 23.

6. *New mode of preparing propionic acid.*—Wanklyn has prepared propionic acid by the action of carbonic acid gas upon sodium-ethyl. When zinc-ethyl is heated with sodium, zinc is precipitated, and a crys-

talline compound containing zinc-ethyl and sodium-ethyl formed. This compound is soluble in excess of zinc-ethyl, and on transmitting a current of carbonic acid over it, great heat is evolved; zinc-ethyl distils off and the contents of the bulb form an amorphous white solid. This solid consists principally of propionate of soda, the reaction being expressed by the equation

$$C_2O_4 + NaCuH_5 = C_6H_5NaO_4.$$

In this manner we have a synthesis corresponding to the well-known analysis of the fatty acids made some years since by Kolbe.—*Quart. Jour. Chem. Soc., No.* xlii, 103.

7. *Purification of hydrogen and carbonic acid.*—Stenhouse has given a very simple and useful method of removing the offensive odor from hydrogen gas prepared from commercial materials. This consists in passing the gas through a layer of coarsely powdered wood-charcoal which absorbs the impurities so that the gas completely loses its odor. The same process may be applied to the purification of carbonic acid gas as evolved by acids from marble or limestone containing organic matter.—*Ann. der Chemie und Pharm.*, cvi, 125.

8. *On the fusion of molybdenum.*—Debray finds that pure metallic molybdenum completely withstands the temperature at which platinum, quartz, &c., become liquid. The metal melts in a crucible of carbon before the oxyhydrogen blowpipe at a temperature at which rhodium fuses, but the fused mass contains 4·5 per cent of carbon. It has a silvery lustre and scratches glass and topaz with ease. Tungsten appears to be even less fusible.—*Comptes Rendus*, xlvi, 1098. W. G.

9. *Crystallization of various Salts.*—A long and able paper on the crystalline form and angles of various artificial salts, by *Marignac*, is published in the Annales des Mines, vol. xii, 5th series, (1857,) pages 1–74. Upwards of 50 species of salts are crystallographically described.

10. *On some properties of Ice near its Melting Point;* by Prof. Forbes, (Proc. Roy. Soc. Edinb., cited from Phil. Jour., vol. viii, No. 1, p. 150.)—"During the last month of March, I made some experiments on the properties of ice near its melting point, with particular reference to those of Mr. Faraday, published in the 'Athenæum' and 'Literary Gazette' for June, 1850, to which attention has been more lately called by Dr. Tyndall and Mr. Huxley in relation to the phenomena of glaciers.

Owing to indisposition, I have been obliged to leave my experiments for the present incomplete. But I am desirous, before the session of the Royal Society closes, to place on record some facts which I have observed, and also some conclusions which I deduce from these and other recent experiments and discussions.

Mr. Faraday's chief fact, to which the term 'regelation' has been more lately applied, is this, that pieces of ice, in a medium above 32°, when closely applied, freeze together; and flannel adheres apparently by congealing to ice under the same circumstances.

1. These observations I have confirmed. But I have also found that metals become frozen to ice when they are surrounded by it, or when they are otherwise prevented from transmitting heat too abundantly. Thus, a pile of shillings being laid on a piece of ice in a warm room,

the lowest shilling, after becoming sunk in the ice, was found firmly attached to it.

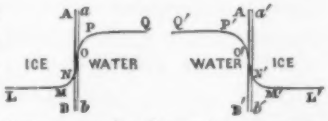
2. Mere *contact*, without *pressure*, is sufficient to produce these effects. Two slabs of ice, having their corresponding surfaces ground tolerably flat, were suspended in an inhabited room upon a horizontal glass rod passing through two holes in the plates of ice, so that the plane of the plates was vertical. Contact of the even surfaces was obtained by means of two very weak pieces of watch-spring. In an hour and a half the cohesion was so complete, that, when violently broken in pieces, many portions of the plates (which had each a surface of twenty or more square inches) continued united. In fact, it appeared as complete as in another experiment where similar surfaces were pressed together by weights. I conclude that the effect of pressure in assisting 'regelation,' is principally or solely due to the larger surfaces of contact obtained by the moulding of the surfaces to one another.

3. Masses of strong ice, which had already for a long time been floating in unfrozen water-casks, or kept for days in a thawing state, being rapidly pounded, showed a temperature 0°·3 Fahrenheit below the true freezing point, indicated by delicate thermometers (both of mercury and alcohol,) carefully tested by long immersions in a considerable mass of pounded ice or snow in a thawing state.

4. Water being carefully frozen into a cylinder several inches long, with the bulb of a thermometer in its axis, and the cylinder being then gradually thawed, or allowed to lie for a considerable time in pounded ice at a thawing temperature, showed also a temperature decidedly inferior to 32°, not less, I think, than 0°·35 Fahrenheit.

I think that the preceding results are all explicable on the one admission, that Person's view of the gradual liquefaction of ice is correct (*Comptes Rendus*, 1850, vol. xxx, p. 526*), or that ice gradually absorbs latent heat from a point very sensibly lower than the zero of the centigrade scale.

I. This explains the permanent lower temperature of the interior of ice.



Let AB be the surface of a block of ice contained in water at what is called a freezing temperature. That temperature is marked by the level of the line QP above some arbitrary zero. LM is, in like manner, the permanent but somewhat lower temperature possessed by the interior of the ice. The space, partly water, partly ice, or partaking of the nature of each, MNOP, has a temperature which varies from point to point, the portion NO corresponding to what may be called the physical surface of the ice between AB and *ab*, which is 'plastic ice,' or 'viscid water,' having the most rapid variation of local temperature.

II. Such a state of temperature, though it is in one sense permanent, is so by compensation of effects. Bodies of different temperatures cannot continue so without interaction. The water *must* give off heat to the ice, but it spends it in an insignificant thaw at the surface, *which therefore*

* Quoted by me in 1851, in my sixteenth letter on Glaciers.

wastes, even though the water be what is called ice cold, or having the temperature of a body of water enclosed in a cavity of ice.*

This waste has yet to be proved; but I have little doubt of it; and it is confirmed by the wasting action of superficial streams on the ice of glaciers, though other circumstances may also contribute to this effect.

III. The theory explains 'regelation.' For let a second plane surface of ice A′B′ be brought up to nearly physical contact with the first surface AB. There is a double film of 'viscid water' isolated between two ice surfaces colder than itself. The former equilibrium is now destroyed. The films AB*ba* and A′B′*b*′*a*′ were kept in a liquid or semi-liquid state by the heat communicated to them by the perfect water beyond. That is now removed, and the film in question has ice colder than itself on both sides. Part of the sensible heat it possesses is given to the neighboring strata which have less heat than itself, and the intercepted film of water in the transition state becomes more or less perfect ice.

Even if the second surface be not of ice, provided it be a bad conductor, the effect is practically the same. For the film of water is robbed of its heat on one hand by the colder ice, and the other badly conducting surface cannot afford warmth enough to keep the water liquid.

This effect is well seen by the instant freezing of a piece of ice to a worsted glove, even when on a warm hand. But metals may act so, provided they are prevented from conveying heat by surrounding them with ice. Thus, as has been shown, metals adhere to melting ice."

II. GEOLOGY.

1. *Tertiary Basin of White and Niobrara Rivers;* by F. V. Hayden, M.D., (Proc. Acad. Nat. Sci., Philad. June, 1858).—In a former paper† I gave a vertical section of the different beds of this basin as far as they were known at that time. During the past year, many additional facts and a large collection of new organic remains have been secured, which enable me to present a section more accurate and complete. It will be at once apparent from the list of localities for the different beds, how extensive a geographical area this basin occupies.

Vertical Section, showing the order of superposition of the different beds of the Tertiary Basin of White and Niobrara Rivers.

Post-Pliocene.—Yellow silicious marl, similar in its character to the loess of the Rhine, passing down into variegated indurated clays and brown and yellow fine grits; contains remains of extinct quadrupeds,

* I incline to think that water, in these circumstances, may, though surrounded by ice, have a fixed temperature somewhat higher than what is called 32°. But I have not yet had an opportunity of verifying the conjecture.

[My idea is, that the invasion of cold from the surrounding ice is spent in producing a very gradual 'regelation' in the water which touches the ice, leaving the interior water in possession of its full dose of latent heat, and also of a temperature which may slightly exceed 32°. By similar reasoning, a small body of ice, inclosed in a large mass of water, will preserve its proper internal temperature *below* 32°; but, instead of regelation taking place, the surface is being gradually thawed. This is the case contemplated in the paragraph of the text to which this note refers.]

† Notes on the Geology of the Mauvaises Terres of White River, Proc. Acad. Nat. Sci., Philad. June, 1857.

The paper above cited from, is the same that is noticed on p. 276 of this volume.

mingled with those identical with recent ones; also a few Mollusca, mostly identical with recent species, so far as determined.

Most fully developed along the Missouri River, from the mouth of the Niobrara to St. Joseph; also in the Platte Valley and on the Loup Fork.

Thicknees, 300 to 500 feet.

Pliocene Tertiary.—Bed F.—1st, dark gray or brown sand, loose, incoherent, with remains of Mastodon, Elephant, &c.; 2d, sand and gravel, incoherent; 3d, yellowish white grit, with many calcareous, arenaceous concretions; 4th, gray sand with a greenish tinge; contains the greater part of the organic remains; 5th, deep yellowish red arenaceous marl; 6th, yellowish gray grit, sometimes quite calcareous, with numerous layers of concretionary limestone from two to six inches in thickness, containing fresh water and land shells, Succinea, Limnea, Paludina, Helix, &c., closely allied and perhaps identical with living species; also much wood of coniferous character.

Covers a very large area on Loup Fork, from the mouth of North Branch to source of Loup Fork; also in the Platte Valley. Most fully developed on the Niobrara River, extending from the mouth of Turtle River three hundred miles up the Niobrara. Also on Bijoux Hills and Medicine Hills. Thinly represented in the valley of White River.

Thickness, 300 to 400 feet.

Miocene.—Bed E.—Usually a coarse-grained sandstone, sometimes heavy bedded and compact; sometimes loose and incoherent; varies much in different localities. Forms immense masses of conglomerate; also contains layers of tabular limestone with indistinct organic remains; very few Mammalian remains detected, and those in a fragmentary condition. Passes gradually into the bed below.

Most fully developed along the upper portion of the Niobrara River, and in the region around Fort Laramie. Seen also on White River, and on Grindstone Hills.

Thickness, 180 to 200 feet.

Miocene.—Bed D.—A dull reddish brown indurated grit, with many layers of silico-calcareous concretions, sometimes forming a heavy bedded fine-grained sandstone; contains comparatively few organic remains.

Niobrara and Platte rivers: well developed in the region of Fort Laramie; also in the valley of White River. Conspicuous, and composing the main part of the dividing ridge between White and Niobrara rivers.

Thickness, 350 to 400 feet.

Bed C.—Very fine yellow calcareous sand, not differing very materially from Bed D, with numerous layers of concretions and rarely organic remains, passing down into a variegated bed, consisting of alternate layers of dark brown clay and light gray calcareous grit, forming bands, of which I counted twenty-seven at one locality, varying from one inch to two feet in thickness.

White River, Bear Creek, Ash Grove Spring, Head of Shyenne River. Most conspicuous near White River.

Thickness, 50 to 80 feet.

Miocene.—Turtle and Oreodon Bed, B.—A deep flesh-colored argillo-calcareous indurated grit; the outside when weathered has the appearance of a plastic clay. Passes down into a gray clay, with layers of

sandstone; underlaid by a flesh-colored argillo-calcareous stratum, containing a profusion of Mammalian and Chelonian remains. Turtle and Oreodon Bed.

Old Woman's Creek, a fork of Shyenne River; also on the head of the South Fork of the Shyenne; most conspicuous on Sage and Bear creeks, and at Ash Grove Spring. Well developed in numerous localities in the valley of White River.

Thickness, 80 to 100 feet.

Miocene.—Titanotherium Bed, A.—Light gray fine sand, with more or less calcareous matter, passing down into an ash-colored plastic clay, with large quantities of quartz grains disseminated through it, sometimes forming aggregated masses like quartzose sandstone cemented with plastic clay; then an ash-colored clay with a greenish tinge, underlaid at base by a light gray and ferruginous silicious sand and gravel, with pinkish bands. Immense quantities of silex in the form of seams all through the beds. Titanotherium Bed.

Old Woman's Creek; also in many localities along the valley of the South Fork of Shyenne, Best development on Sage and Bear Creeks. Seen at several localities in the valley of White River.

Thickness, 80 to 100 feet.

Cretaceous.—Nos. 4 and 5.—Cretaceous beds 5 and 4, with their usual lithological characters and fossils.

Exposed underneath the Tertiary Beds on the South Fork of Shyenne and its southern branches, also in White River Valley near its source.

Catalogue of all the Fossils hitherto described from the Tertiary Formations of White and Niobrara rivers, with a Table showing their stratigraphical position.

RUMINANTIA.	Beds in Ascending order. A	B	C	D	E	F
1. Oreodon gracilis, *Leidy*	..	*	*	*	*	..
2. Oreodon Culberstoni, *Leidy*	..	*	*	*	..	..
3. Oreodon major, *Leidy*	..	*	..	*	..	..
4. Agriochœrus major, *Leidy*	..	*	..	*	..	..
5. Agriochœrus antiquus, *Leidy*	..	*	..	*	..	..
6. Poebrotherium Wilsoni, *Leidy*	..	*	..	..	..	..
7. Leptomeryx Evansi. *Leidy*	..	*	..	*	..	..
8. Leptauchenia decoran, *Leidy*	..	..	..	*	..	..
9. Leptauchenia major, *Leidy*	..	..	..	*	..	..
10. Protomeryx Halli, *Leidy*	..	..	..	*	..	..
11. Merycodus necatus, *Leidy*	..	..	..	..	..	*
12. Megalomeryx niobrarensis, *Leidy*	..	..	..	..	..	*
13. Merychochœrus proprius, *Leidy*	..	..	..	*	..	..
14. Procamelus occidentalis, *Leidy*	..	..	..	..	..	*
15. Procamelus robustus, *Leidy*	..	..	..	..	..	*
16. Procamelus gracilis, *Leidy*	..	..	..	..	..	*
17. Merychyus elegans, *Leidy*	..	..	..	..	..	*
18. Merychyus medius, *Leidy*	..	..	..	..	..	*
19. Merychyus major, *Leidy*	..	..	..	..	..	*
20. Cervus Warreni, *Leidy*	..	..	..	..	..	*

	Beds in Ascending order.					
MULTUNGULA.	A	B	C	D	E	F
21. Chœropotamus (Hyopotamus) Americanus, *Leidy*	*	..	..	..	..	..
22. Entelodon Mortoni, *Leidy*	..	*	..	*	..	..
23. Entelodon ingens, *Leidy*	..	*	..	*	..	..
24. Titanotherium Prouti, *Leidy*	*	..	..	..	..	..
26. Paleochœrus probus, *Leidy*	..	*	..	*	..	..
27. Leptochœrus spectabilis, *Leidy*	..	*	..	*	..	..
28. Rhinoceros occidentalis, *Leidy*	..	*	*	*	*	..
29. Rhinoceros (Hyracodon) nebrascenis, *Leidy*	..	*	*	*	*	..
30. Rhinoceros crassus, *Leidy*	..	..	..	..	..	*
31. Mastodon (Tetralophodon) merificus, *Leidy*	..	..	..	..	..	*
32. Elephas (Euelephas) imperator, *Leidy*	..	..	..	..	..	*
SOLIDUNGULA.						
33. Hipparion, s. Hippotherium occidentale, *Leidy*	..	..	..	..	..	*
34. Hipparion, s. Hippotherium speciosum, *Leidy*	..	..	..	..	..	*
35. Anchitherium Bairdi, *Leidy*	..	*	..	..	..	..
36. Anchitherium (Hypohippus) affinis, *Leidy*	..	..	..	*	..	..
37. Anchitherium (Parahippus) cognatus, *Leidy*	..	..	..	*	..	..
38. Merychippus insignis, *Leidy*	..	..	..	..	..	*
39. Merychippus mirabilis, *Leidy*	..	..	..	..	..	*
40. Equus excelsus, *Leidy*	..	..	..	..	..	*
41. Equus (Protohippus) perditus, *Leidy*	..	..	..	..	..	*
RODENTIA.						
42. Steneofiber nebrascensis, *Leidy*	..	..	*	*	..	..
43. Ischyromys typus, *Leidy*	..	..	*	*	..	..
44. Palæolagus Haydeni, *Leidy*	..	..	*	*	..	..
45. Eumys elegans, *Leidy*	..	*	..	..	..	..
46. Hystrix (Hystricops) venustus, *Leidy*	..	..	..	*	..	*
47. Castor (Eucastor) tortus, *Leidy*	..	..	..	..	..	*
CARNIVORA.						
48. Hyænodon horridus, *Leidy*	..	*	..	..	..	..
49. Hyænodon cruentus, *Leidy*	..	*	..	..	..	..
50. Hyænodon crucians, *Leidy*	..	*	..	..	..	..
51. Amphicyon vetus, *Leidy*	..	*	..	..	..	..
52. Amphicyon gracilis, *Leidy*	..	*	..	..	..	..
53. Leptarctus primus, *Leidy*	..	..	..	..	..	*
54. Deinictis felina, *Leidy*	..	*	..	..	..	..
55. Machærodus primævus, *Leidy*	..	*	..	..	..	..
56. Felis (Pseudœlurus) intrepidus, *Leidy*	..	..	..	..	..	*
57. Ælurodon ferox, *Leidy*	..	..	..	..	..	*
58. Canis sævus, *Leidy*	..	..	..	..	..	*
59. Canis temerarius, *Leidy*	..	..	..	..	..	*
60. Canis vafer, *Leidy*	..	..	..	..	..	*
61. Canis (Epicyon) Haydeni, *Leidy*	..	..	..	..	..	*

	Beds in Ascending order.					
	A	B	C	D	E	F
CHELONIA.						
62. Testudo nebrascensis, *Leidy*	..	*	*	*	*	..
63. Testudo (Stylemys) niobrarensis, *Leidy*	..	..	..	..	..	*
MOLLUSCA.						
64. Helix Leidyi, *Hall & Meek*	..	*	..	..	..	..
65. Planorbis nebrascensis, *Evans & Shumard*	..	..	..	*	..	..
66. Lymnea diaphana, *Evans & Shumard*	..	..	..	*	..	..
67. Lymnea nebrascensis, *Evans & Shumard*	..	..	..	*	..	..
68. Physa secalina, *Evans & Shumard*	..	..	..	*	..	..
CRUSTACEA.						
69. Cypris Leidyi, *Evans & Shumard*	..	..	..	*	..	..

2. *Letter from* G. Garcia Moreno, *to* Prof. W. Jameson, *relative to the Exploration of the Volcano of Pichincha*, dated Quito, 13th January, 1858, (cited from Edinb. New Phil. Jour., vol. vii, April, 1858.)—The following is a brief account of my last exploring expedition to the volcano which overlooks Quito. The short distance at which the volcano Rucu-Pichincha is situated from this city, has contributed to excite the curiosity of the scientific travellers who have visited the territory of the Ecuador, and have caused the state and form of the volcano to be well known. Bouguer and La Condamine, in 1742, were the first who reached the brink of the crater; the celebrated Alexander Humboldt, in May 1802, twice surmounted the gigantic wall of dolerite which forms the eastern border of the volcano; and about thirty years after, your countryman, the unfortunate Colonel Hall, and M. Boussingault, followed in the same path; but since 1844, in which M. Sebastin Wisse and I descended to explore it, no one had reached the bottom. In August 1845, we returned with the intention of making the topographical plan of the volcano, measuring heights, &c.; and in order that we might do this, we had to pass three days and three nights in the two deepest cavities which form Rucu-Pichincha.

In an orographical view, our second expedition gave us the results which we longed for. Rucu-Pichincha, placed to the S. W. of Quito, forms two great basins, one to the east of the other, 4921 English feet in length. The eastern basin, called, without sufficient reason, "Eastern Crater," has the form of a narrow valley, long and deep, through the middle of which passes from north to south a fissure which receives the rain and melted snow: there exists a slight depression in the upper part of this basin of an elliptical form, and perfectly horizontal at the bottom, similar in everything to a little alpine lake dried up by the action of the sun; a depression which at one time, from its form, gave rise to the belief in the existence of an inactive crater. The depth of this supposed crater is 1050 feet below the wall of eastern rocks; and as the highest of these reaches to 15,748 feet above the level of the sea, the height of the bottom of the eastern crater is 14,875 feet.

The western basin, or, more properly, the true crater of Pichincha, is one of the most imposing objects which is presented to naturalists—

placed on the western slope of Rucu-Pichincha, differing from the other craters of the Ecuador, which takes the form at the summit of a regular cone covered with snow, it presents the figure of a truncated cone placed upon its inferior base, which is 1476 feet in diameter, and rises in height to 2296 feet. Its depth from the eastern side is enormous; and gazing upon the immense towers of dolerite and trachyte elevated 2460 feet, sometimes vertically, sometimes in slopes more or less steep and varied, an impression is received which can never be effaced. Towards the western part, the height of the walls of the crater diminishes gradually, leaving open to the east a fissure from whence the united waters escape during the rains or thaws.

In the middle of the inclined plain which constitutes the bottom of the volcano, the actual cone of eruption rises; it is 820 feet in diameter, 262 in height above the bottom of the middle of the crater, and 13,707 above the level of the sea, standing 4166 feet above Quito. This little mountain is now the centre of volcanic activity in Pichincha, and presented in 1845 clear indications of remaining permanent many years without increase of intensity. A great part of this mountain is covered with vegetation; two regions, parting in opposite direction, completely gird it, until they are united in the cleft of which I have spoken; and in the two points from whence the cone of eruption is depressed (one to the centre, the other to the S.E.) there is given out in abundance a hot and sulphurous vapor which lines with sulphur the holes and interstices between the fragments of rock of which the cone is composed.

We failed, in the expedition of 1845, to study the volcanic and vegetable products which the crater presented. In order to examine its actual state, and to fill this blank, I descended on the 16th of last December, carrying, as far as possible, what was necessary for the perilous situations in which I expected to be placed. I was engaged little more than three hours in the descent; and half-past eleven of the day found me at the cone of eruption. The form which this presents, proves that the bottom of Pinchincha has been recently the theatre of considerable convulsions. The vegetation which covered it has disappeared from the eastern side; the depression which exists towards the southeast, at the foot of the cone, has widened itself, and has filled up a part of the broken inclosure, interrupting it perpendicularly with a broad wall of stones, undoubtedly shot out from its interior. Near to this, and towards the south, it has formed, since 1845, a new depression, or, speaking more properly, a new accidental crater, from whence arises a great mass of vapor, so that the cone of eruption has at present three apertures or craters: the principal occupying the higher part; the ancient accidental crater, placed at the southeast, and at the foot of the former; and the new accidental crater, open likewise at the foot and at the south of the principal one.

The volcanic activity of Pichincha has increased remarkably, as is manifested by the greater exhalation of vapors. In 1845, the chimneys from whence the gases arose formed six groups, of which only one was considerable. Now the vapors escape by innumerable interstices and hollows, which the stones leave in each of the craters; and in the princi-

pal one is heard a noise resembling that made by an immense cauldron of boiling water.

The temperature of the vapors varies much in the different interstices. In the crater of the southeast, the vapors of the highest interstices are nearly 188°·6 Fahr., whilst in the lower ones the temperature was only 140° Fahr. In the principal crater, the hottest vapors did not come up to 194° Fahr.; in the largest interstice that I have observed, into which a person could easily enter, if the thick column of vapor would permit him, the temperature was only 98·6° Fahr. at three feet of depth. Filling a graduated tube with water, and placing it within the interstices, I collected the gases several times in order to analyze them, and, moreover, condensed them by means of a bottle filled with cold water, and gathered the drops of fluid which were formed. The result of my observations is, that the gases of Pichincha contain a scarcely perceptible trace of sulphurous, sulphuric, and sulphydric acid, four per cent of carbonic acid, and the rest composed exclusively of water. I present these results only as approximate ones. The atmospheric air is always mixed with the volcanic gases in those points where it is possible to collect it; and this cause of error is inevitable, without reckoning those which occur from the personal difficulties of the observer.

The solid products of the volcano are the sublimed sulphur which covers almost all the stones and fissures; and a white salt which appears in silky fibres, and shows itself in many of the interstices, sometimes alternating with the flower of sulphur in parallel coatings, sometimes in an abundant and pure mass. This salt is a double sulphate of alum and of the protoxyd of iron, likewise formed in other volcanoes, and known by the name of "*alumbre de pluma*," or plumose alum. Dissolved in water, it crystallizes by spontaneous evaporation in a derivative form of the oblique rhomboidal prism. Besides these products, there is found scoria, composed of melted sulphur and ashes of pyroxene and dolerite, more or less calcined or altered by the action of the watery vapors.

The plants which I collected in the crater, and which you had the goodness to name, are: *Alchemilla nivalis*, *Ranunculus Gusmanni*, *Jamesonia* sp. (these two plants were found nowhere else but on the ridge of Pichincha); *Culcitium reflexum*, *Werneria graminifolia*; *Gaultheria myrsinoides* (the space of ground in which this little shrub grew, showed a high degree of temperature—87° Fahr.); *Polypodium crenulatum*, *Porerretia pyramidata*.

I came out of Pichincha on the 17th of December, after having passed the previous night within the crater, and at 493 feet from the cone of eruption. Desirous of continuing my observations, I retain the hope of returning to the crater in the present year, in order to pass some days within it; I consider my late expedition only as a preparatory and necessary step towards another more important one. Before undertaking it, I will ascertain the point from whence the descent to the bottom of Pichincha is likely to be easiest, avoiding the imminent peril of precipitating oneself when descending the eastern wall. In 1844, M. Wisse fortunately saved himself in time from rolling headlong into a horrible abyss. A similar accident befell me in 1845; and in December last year, your son, who accompanied me, nearly found his grave in the

abyss. I have no doubt that in descending 2460 feet of rocks, in which hands are more useful than feet, a single rash step would be followed by fatal consequences.

3. *Metamorphism*, (L'Institut, No. 1282, July, 1858.)—DEVILLE impregnated a piece of chalk with chlorid of magnesium and then heated it for a long time in a platinum crucible in a sand-bath. By a temperature of about 100° C., six to seven per cent of lime were replaced by magnesia. Washing and repeating this eight times, the ratio of magnesia to the lime was 1 : 2, or nearly that of a true dolomite (which is 1 : $1\frac{1}{2}$).

In this reaction, however, some carbonic acid was given off and oxychlorid formed. But on exposing the piece in water to the atmosphere, a little pure carbonate of lime formed and separated with the chlorid and left a neutral dolomite. It was an unexpected result to find the carbonic acid of the atmosphere promoting this result, while a saturated solution of carbonic acid leads to the formation of bicarbonates.

Deville impregnated a sandstone which contained no lime with a mixed solution of chlorid of calcium and magnesium and submitted it to the action of a good red heat. After several repetitions of the process, the mass became spongy and more absorbent. Pulverized and raised to a white heat, it fused to a milk-white mass consisting of interlaced crystalline fibres. Its specific gravity was 3·0; it was not attacked by acids; it contained no chlorine, but consisted of

$\dot{S}i$ 56·0 $\dot{C}a$ 26·3 $\dot{M}g$ 17·7

equivalent to $(\dot{C}a, \dot{M}g)^3\,\dot{S}i^2$, or a variety of pyroxene.

4. *Diprotodon trilobus, a new fossil Marsupial in Australia.*—A new species of the marsupial genus Diprotodon, as large as an ox, has been found fossil at King's Creek, Darling Downs, in New South Wales. The skull is eighteen inches long, and fifteen wide where broadest, being very broad for its length. The species of Diprotodon before described has the skull proportionally narrower, it being about three feet long and one foot eight inches broad. It is called the *Zygomaturus trilobus* by Macleay of Australia; but according to Prof. Owen, the genus is probably not distinct from Diprotodon.

5. *Permian System of England.*—A paper on the rocks and fossils of the Permian of the counties of Durham and Northumberland, by R. House, is contained in the Annals and Magazine of Natural History, [2], vol. xix, (1857), pages 33, 304 and 463, and plate 4.

6. *Peak of Aconcagua.*—The height of the peak of Aconcagua in the Chilian Andes, according to the recent measurements of Mr. Pissis is 6,834 meters, 304 meters above Chimborazo. It was made 7,287 meters (23,910 feet) by Beechey and Fitzroy.

7. *Mastodon giganteus.*—A tooth of the Mastodon has been found near Morpeth, Canada West.

8. *Iowa Geological Report.*—We are authorized to state that this Report, by Prof. JAMES HALL and J. D. WHITNEY, is nearly ready to be issued. The work is one of great interest in all its departments. It contains descriptions and plates of numerous fossils, and is exceedingly rich on the subject of Crinoids.

III. BOTANY AND ZOOLOGY.

1. Martius: *Flora Brasiliensis:* Fasc. 18, in two parts, 1857–8. Fasc. 19 & 20, 1857.—The 18th portion of this elaborate work is occupied with one of the larger tropical families, viz: the *Myrtaceæ*, and forms a goodly volume of 527 pages, illustrated by 82 plates. It also contains two lithographed views of Brazilian vegetation, and a fine map of almost all South America, exhibiting the routes of the principal botanical explorers, from Ruiz and Pavon, and Humboldt, down to Castelnau, Weddell, and Spruce. This will be very useful to botanists. The *Myrtaceæ* are elaborated by Otto Berg, a young Prussian Botanist, who has at the same time made a revision of all the known American plants of the order, in the Linnæa. He gives us no less than 51 genera, of which 42 occur in the Brazilian empire. The nature-printing process of Auer, is advantageously introduced to exhibit the venation of Myrtaceous leaves; and seven plates are filled with individual leaves of a considerable number of species.

In Fasc. 19 & 20, Dr. Fresenius, of Frankfort, has elaborated the Brazilian *Cordiaceæ*, *Heliotropicæ*, (which he regards as distinct orders,) and the few *Borragineæ* proper. Prof. Schnizlein contributes the *Lacistemaceæ*, of the single genus *Lacistema;* and Tulasne the *Moniniaceæ*, forming a supplement to his beautiful monograph of that order. There are two Brazilian genera, *Citriosma*, of 26 species, and *Mollinenda*, of 16.

A. G.

2. *Journal of the Proceedings of the Linnæan Society*, No. 9.—The botanical portion is filled by Prof. Lindley with the second part of his "Contributions to the Orchidology of India," and with the characters of a remarkable new Orchideous genus, *Pseudocentrum*, founded on a plant gathered in Peru by Prof. Jameson. The name is suggested by a curious caudate appendage or false spur, borne at the apex instead of the base of the labellum. Botanical papers of interest having accumulated in the hands of the Council, it is announced that supplemental botanical numbers of the Journal will be published during the current year. The first will contain an "Enumeration of the Mosses of the East Indies," by Mr. Mitten.

A. G.

3. *Lichenes Americæ Septentrionalis Exsiccati, Curante* Edvardo Tuckerman, A. M., etc. Fasc. V, and VI, Bostoniæ, Nov. Angl. 1854.—Notwithstanding the date of the title page, we believe the present volume was issued to subscribers in general only during the present year, much time having been occupied in the collection, faithful examination, and preparation of a sufficient number of these admirable specimens. This volume carries the number of species, or distinct varieties, from 101 to 150, and contains several new or rare and recently detected Lichenes, as well as characteristic and perfectly authenticated specimens of common sorts. Prof. Tuckerman's high reputation as a Lichenologist, causes these sets to be greatly sought after, at home and abroad. Here they are indispensable to the successful study of our Lichenes. All that can be needed besides, is a new edition of the synopsis of the Lichenes of the United States, from the same able hand. The fine series of forms of *Cladonia*, in these and the previous volumes, are important; and Mr. Russell's new Collemaceous genus *Leptogium* (No. 150) is worthy of particular attention.

A. G.

4. NYLANDER: *Synopsis Methodica Lichenum omnium hucusque cognitorum, præmissa Introductione Lingua Gallica tractata.* Fasc. I. Paris, 1858, imp. 8vo.—This is to be the standard systematic work upon Lichenes. The author, the Acharius of his day, after long investigating, with wonderful zeal and success, the Lichenes of his native Scandinavian regions, repaired to Paris and to Kew, where he has for several years studied the collections accumulated in the principal European herbaria, and he has also been furnished with materials directly from this country. This first fasciculus of the synopsis, which is to embody the result of a complete revision of the order, contains an introduction of 81 pages, in the French language, giving an account of the structure and properties of Lichenes, the principles of their classification, and their geographical distribution. The structure is illustrated by four plates. Of the systematic portion of the work, this fasciculus contains the *Collemacei* and the *Myriangeacei*. Two opuscula, issued by the same author during the past summer, are,

Énumeration Générale des Lichens, avec l'Indication sommaire de leur Distribution Geographique. (*Extr. des Mém. Soc. Imp. des Sciences Naturelles de Cherbourg.*) pp. 146. 8vo.

Expositio Synopticia Pyrenocarpeorum. (*Extr. Mem. Soc. Acad. de Maine et Loire.*) pp. 88. 8vo. A. G.

5. MIERS: *Illustrations of South American Plants*, Vol. II. London, 1849, 1857. 4to.—The letter-press consists of a series of articles contributed to the Annals and Magazine of Natural History. A separate impression, in 4to form, is now issued, illustrated by 53 excellent plates. drawn by the accomplished author, and most of them lithographed by his own hand. This volume is mainly devoted to the order *Solanaceæ*, or its immediate allies; to showing the invalidity of the line which had been drawn between the *Solanaceæ* and the *Scrophulariaceæ*, and to an endeavor at clearer distinctions, through the establishment of an intermediate order, the *Atropaceæ*. The earlier sheets were issued some time previous to the appearance of the late M. Dunal's recension of the Solanaceæ in the 13th volume of De Candolle's Prodromus. The latter ones are subsequent to this publication, and contain severe criticisms upon it. The removal of the *Salpiglossideæ* from the *Scrophulariaceæ* (where Bentham had left them with much hesitation) certainly renders it more possible to limit the latter order in this direction than it was before. But the proposed order, *Atropaceæ*, probably will hardly serve its purpose. A most useful part of this volume, is the monograph of the genus *Lycium*, comprising (after considerable exclusions) 69 species, almost all of them illustrated by excellent analyses. In this department, Mr. Miers particularly excels. His whole labors, as recorded in this and the preceding volume, have thrown much light over Solanaceous plants, and will command the attention of their next monographer. A. G.

6. *Hand-book of the British Flora; a Description of the Flowering Plants and Ferns indigenous to, or naturalized in, the British Isles: for the use of Beginners and Amateurs;* by GEORGE BENTHAM, F.L.S. London: Lowell Reeve, 1858; pp. 655, 12mo.—One of the best of systematic botanists,—of the soundest judgment and the largest experience, both in European and exotic botany,—has deemed it no unfit employ-

ment of a portion of his valuable time to prepare a volume by which beginners, having no previous acquaintance with the science, may learn to know, most advantageously and readily, the wild flowers and plants of his native land. The result is a genuine popular Flora, and a clear proof that the plants of a limited country may be described, by one who understands them thoroughly, in comparatively simple language, without any sacrifice of scientific accuracy, or of scientific interest. No really good work of this kind was ever made by a compiler; and no one who has not essayed the task, can comprehend how thoroughly faithful writing for beginners brings one's knowledge to the proof.

The characteristic features of the work before us, are: 1, The full use of analytical keys, after the mode of De Candolle's *Flora Française*, leading easily not only to the order and the genus, but also to the species of the plant in hand. These keys, or analyses, are here made to supersede specific characters as such, neat and free descriptions, longer or shorter according to circumstances, occupying their place. But generic characters are given with considerable fullness. 2, The exclusion of all technical terms which were not required for the purpose in view, and "the omission, in numerous instances, of microscopical, anatomical, or theoretical characters, often of the greatest importance in scientific botany but useless to the mere amateur." 3, The descriptions are original, and have been drawn up from British specimens, in the first instance, and afterwards compared with the characters given in the standard Floras, and verified upon continental specimens from various parts of the geographical range of the species. As a describer of species, (which is something very different from describing *specimens*,) Mr. Bentham has no superior. 4, The geographical range of each species, at least its European range, is carefully specified: then the British stations are given, in general terms, the object being to state where the plant is likely to be found, rather than to indicate the precise spot where it has been gathered. 5, The judicious limitation of species, and the reduction of a crowd of nominal or 'critical' species to their supposed types, with a thoroughness which only a botanist of Mr. Bentham's great experience and authority could well venture upon. The following extract from the preface will explain his views:

"Taking into account the omission of all plants erroneously indicated as British, it will still, no doubt, be a matter of astonishment that, whilst the last edition of Hooker and Arnott's Flora contains 1571 species, and that of Babington's Manual as many as 1708, (exclusive of *Chara*,) that the number, in the present work, is reduced to 1285. This is not owing to any real difference of opinion as to the richness and diversity of our vegetable productions, but is occasioned by a different appreciation of the value of the species themselves. The author has long been persuaded that the views originally entertained by Linnæus, of what really constitutes a species, were far more correct than the more limited sense to which many modern botanists seem inclined to restrict the term; and that in most cases where that great master had good means of observation, he succeeded admirably in the practical application of his principles. At any rate, if those minute distinctions by which the innumerable varieties of Brambles, of Roses, of Hawk-weeds, or of Willows, have

of late years been characterized, and really more constant and more important than the author's experience has led him to conclude, they cannot be understood without a more complete acquaintance with trifling, vague, and sometimes theoretical characters, than he has himself been able to attain, or than can ever be expected from the mere amateur. * * * The species are limited according to what are conceived to have been the original principles of Linnæus: and the author, in submitting his views to the judgment of the scientific world, trusts that they will not be attributed to hasty generalizations, or conjectural theories, but that they will be generally recognized as founded on personal observation of living plants, made during many years' residence on the Continent, as well as in this country, and on repeated comparison of specimens collected from the most varied and distant points of the geographical areas of the several species."

6, Popular names are employed and reduced to a system, in accordance with the principles of botanical nomenclature. "An attempt has, on the present occasion, been made to give prominence to a series of English names to the British plants, rendering them as far as possible consistent with the recognized principles of systematic nomenclature, so essential for the study of plants. It was at first intended merely to have adopted those which are appended to all the genera and species in Hooker and Arnott's Flora; but the first attempts to apply them practically, gave evidence that they had never been framed with a view to being used by botanists, or amateurs, in place of the Latin ones. It will be observed that there is among them a continual confusion between popular, trivial, and generic names; between epithets and specific names; between substantives and adjectives; that on frequent occasions one name is applied to several genera, or several names to one genus; that the number of words forming the name of a plant varies from one to five, instead of being constantly two; and that some of the names put forward as English, are very local, almost unknown, or obsolete, and no easier to learn than the more useful Latin ones they represent. It became necessary, therefore, thoroughly to revise the whole system, and to recast it upon the Linnæan principles universally adopted for the Latin botanical names. * * * * The full statement of the principles which have induced the rejection of certain names, and the substitution of others, and the details of their application to individual cases, * * are given at length in a paper prepared by the author, to be laid before the Linnæan Society on the publication of this Flora."

Criticism may well be deferred until this paper comes to hand. Of the propriety of an English nomenclature of some kind in a Flora where a great part of the plants have well-known vernacular names, there is no room for doubt; and if used at all, it is desirable that these names should be reduced to a systematic form. This is readily done for perhaps half of the common plants of the British Flora; but for the rest, the difficulties are various and much greater than one would imagine before making the attempt. The present undertaking must be deemed a decided success. What imperfections it has, are on the safer side. We should have inclined to a larger use of the vernacular for generic names; and where they were inapplicable to whole genera, to apply them to sub-

genera, e. g.: Apple and Pear, Gooseberry and Currant. As these are real and universal English generic names, they ought, if possible, to be given as such. Still we appreciate the reasons which appear to have compelled the adoption of *Pyrus* and *Ribes* as English names, though English they never can become. Our author is strongly disposed throughout to make the Latin name do duty as an English one, doubtless supposing that they may become popular appellations in time, as *Geranium* and *Aster* have done. Sometimes he adopts the Latin word entire: sometimes he truncates or anglicises the termination. Happy instances of the latter sort, are:

Trigonel, from Trigonella.
Limosel, from Limozella.
Corydal, from Corydalis.
Corrigiole, from Corrigiola.
Chrysosplene, from Chrysosplenium; but why not *Golden-spleen?*
Samole, from Samolus; but why not *Brookweed?*
Limnanth, from Limnanthemum.
Scleranth, from Scleranthus; but why not *Knawel?*
Osmund, from Osmunda.
Myriophyll, from Myriophyllum; but why not *Milfoil?*
Matricary, for Matricaria.
Eupatory, for Eupatorium, etc.

Those names which are not at all to our taste, are:

Cerast, for Cerastium; but if such a word must be coined, why not *Holost*, for Holosteum on the preceding page?
Doronic, for Doronicum.
Onopord, for Onopordon; why not *Cotton-Thistle?*
Polycarp, (newly martyred,) for Polycarpon.
Myosote, for Myosotis; in place of *Forget-me-Not.*
Capsell, for Capsella; in place of the vernacular *Shepherd's-purse.*

The best coinage of an English name is *Rockcist* for Helianthemum.

An Introduction of 36 pages, teaches the elements of botany to beginners, and explains the technical terms used in the flora, and many besides. The definitions of *perigynous* and *epigynous*, however conformable to etymology, are not the quite usual ones, and are not adhered to in the work itself. We were not aware that "in general the word *ovary* is used to designate all the ovaries of a flower," unless when united into one body, and are glad to observe that the author does not use the word in this way in the body of the work, one or two instances excepted. We always supposed the word to be an exact synonym of the Linnæan *germen*. And if we may not use it, as botanists always have done, for the ovule-bearing portion of the pistil, whether simple or compound (reserving *carpel* for the simple or elementary pistil, whether separate or combined,) then a new word must needs be coined for this very purpose. To mistake the radicle of the embryo for the root, is common to all English botanists. The short sections upon classification and the examination and determination of plants, are full of practical wisdom. A. G.

7. *Vegetation around the Volcanic Craters of the Island of Java;* by M. H. Zollinger, (Bib. Univ., from Edinb. New Phil. Jour., April, 1858, p.

322.)—Decandolle, in his *Geographie Botanique*, has omitted to notice among vegetable stations that around volcanic craters. In Java there are more than sixty of these craters, all isolated and surrounded by vast virgin forests. When the craters are active and send forth lava, (which is not the case with the Java volcanoes,) or cinders, or sand and fragments of rock, or when they exhale continually vapors and gases, then there is no vegetation, except some Oscillarias, which are found in hot water springs. It is only when the direct volcanic action is diminished by the effect of time, or the distance of the crater, that a special vegetation appears. The craters of the Indian Archipelago are characterized by the absence of all parasitic or epiphytic plants, as well as of climbing and twining plants. Woody plants only appear at a considerable distance from the craters. We can easily distinguish three different regions: 1, an interior zone, nearest to the centre of volcanic action; 2, A middle zone surrounding the first; 3, An exterior zone.

I. *Interior Zone.*—This exhibits mostly small species scattered here and there, belonging to the lower order of plants, and to those having no corolla. Among them are, *Oscillaria labyrinthiformis*, Ag?, in warm springs; *Caladodia macilenta*, Hoff., and *C. bacillaris* or *obtusa* of Schær.; some Fungi belonging to the genus *Polyporus;* a *Marchantia;* two or three specimens of mosses; some ferns, such as *Selliguea Feei*, Bory, *Polypodium triquetrum*, Bl., *Asplenium macropyllum*, Bl., *Asplenium mucronifolium*, Bl., and *Gleichenia vulcanica*, Bl. Among Cyperaceæ, *Phacellanthus multiflorus*, Steud. *Polygonum corymbosum*, Bl., is the only Dicotyledon.

II. *Middle Region.*—Many social ferns occur here, some Dicotyledons, for the most part small shrubby plants. Among the ferns are: *Polypodium Horsefieldii*, R. Br. (3000—8000 feet), *Pteris aurita*, Bl. *Blechnum pyrophyllum*, Bl. *Gleichenia ferruginea*, Bl., *Mertensia longissima*, Kze., *Lycopodium spectabile*, Bl., *L. trichiatum*, Bory. We also meet still with *Phacellanthus multiflorus*, a Carex, *Polygonum corymbosum*, and *Imperata arundinacea*. A species of *Antennaria* and *Anaphalis* among Compositæ, and certain Ericaceæ appear; also, *Leontopodium*, *Elsholtzia elata*, *Wahlenbergia lavendulæfolia*, DC., *Ophelia javanica*. Hassk., *O. cærulescens*, Zoll., *Melastoma setigerum*, Bl. (the cells of which are said by M. Zollinger to contain crystals of pure sulphur), *Medinilla javensis*, Bl., *Rubus lineatus*, Reinw., besides other genera and species.

III. *Exterior Region.*—This region gradually loses itself in the ordinary forest vegetation. Some rare mosses, ferns, and orchids appear at the outer portion of the region. Among other plants may be noticed *Synœcia* (Ficus) *diversifolia*, Miq., *Rhododendron javanicum*, Reinw., *Agapetes elliptica*, Don, &c. Among the common arborescent plants may be mentioned, *Agapetes varingiæfolia* Don, *A. myrtoides*, fem. *Myrsine avenis*, Bl. The beautiful *Albizzia montana*, Bth. (a social plant), *Casuarina montana*, Lesch, and *C. Junghunhniana*, Miq., are on the outer part of the region. We find also here an arborescent *Boehmeria* and a dwarf *Epilobium*. Some twining plants form transition species, such as *Nepenthes gymnamphora*, Bl., and some varieties of *Polygonum corym-*

bosum. The order Ericaceæ is the predominant one; we find, beside the species already mentioned, *Rhododendron album*, Bl. (?), *Agapetes floribunda*, Don, and other species of the genus, *Gaylussacia lanceolata*, Bl., *Parnettia repens*, Zoll., *Gaultheria punctata*, Bl. (an odoriferous plant of great beauty), *G. leucocarpa*, Bl., and others; species of *Clethra* (?). The genus Rubus is well represented. *Dodonæa viscosa*, Andr. (?), is common towards the eastern part. The orchid that approaches nearest the craters, is *Thelymitra javanica*, Bl.

These are the more common and more characteristic plants of the three crateric regions of Java, according to M. Zollinger.

8. *The Lotus or Sacred Bean of India.*—Dr. Buist gives some notes on the Lotus or Sacred Bean of India, in the Transactions of the Bombay Geographical Society. He says, "The lotus itself is one of the most elegant of eastern flowers, and seems from time immemorial to have been, in native estimation, the type of the beautiful. It is held sacred throughout the East, and the deities of the various sects in that quarter of the world are almost invariably represented as either decorated with its flowers, seated or standing on a lotus throne or pedestal, or holding a sceptre formed from its flowers, sometimes expanded and at others closed. It is fabled that the flowers obtained their red color by being dyed with the blood of Siva, when Kamadeva wounded him with the love-shaft arrow. Lakshmi is called the lotus-born from having ascended from the ocean on its flowers. The lotus is often referred to by the Hindu poets. The lotus floating on the water is the emblem of the world. It is also the type of the mountain Meru, the residence of the gods, and the emblem of female beauty.

The lotus flower is repeated, *ad infinitum*, in the earliest eastern sculptures, as that on which Bhuddah sat, and from which Bramah sprung. In the Cave Temples of Salsette, dated back several centuries before the Christian era, it is represented everywhere at once as an emblem and an ornament.

Dr. Buist thinks that Dr. Lindley is mistaken in saying that the wicks used on sacred occasions by the Hindoos, are made of the spiral vessels of the leaves of the lotus. They are formed, he says, of the dried flower-stalk or leaf-stalk; he does not believe that all the spirals of all the lotuses in India, from the Himalayas to the line, would make a lump of wick a yard long of the thickness of the finger. Individually the spirals are finer than gossamer; the leaf is fourteen by sixteen inches in diameter; the stalks about six by eight feet long, and seldom rise higher than two or two and a half feet above the surface of the water. The leaf is buoyant enough to support a crow, and is frequently made use of by that bird as a fishing station, from which flies, snails, or water lizards, are preyed upon. The flower has something of the smell of the Tonquin bean, or the blossom of the bean. The upper surface of the leaf is a deep green. It repels the water when pressed under it. This is referred to in some of the native writings, a translation of one of which is given by Dr. Buist:

> "He is not enslaved by any lust whatever;
> By the stain of passion he is not soiled,
> As in the water, yet unwet by the water,
> Is the Lotus leaf."

When the leaf is held obliquely, the light is reflected as if from a mirror. The same thing occurs with drops of water thrown upon it, and this peculiarity can only be overcome by rubbing the leaf so as to destroy the fine texture, by which the result is brought about. This seems to consist of minute capitate papillæ, by which a fine film of air is kept entangled, the water in reality never coming in contact with the actual surface of the leaf at all—a fact established and illustrated by its reflecting light from its own under surface. The same phenomenon of repulsion of water is seen in the leaves of the *Pistia stratiotes*, a floating plant abounding in shallow tanks in India. When pressed under water the leaves look like frosted silver. It is the same organization that enables roses, clover, and young cabbage leaves, young shoots of grain and grass, and the numberless other plants that exhibit dew in its beautiful pearly form, to repel water from their surface. It is the same that produces the like results usually ascribed to oil and grease on the feathers of birds, especially of water-fowls, and most of all of divers—which when they plunge under the surface seem to carry with them a perfect flash of light. A piece of glass, a varnished or greased surface, or polished stone, throws the water off as perfectly as the various matters enumerated, but in none of these latter cases is there any appearance of reflection.

Dr. Buist, on examining the lotus leaf in a little pool of water, noticed thin films of air arising leisurely and adhering to the leaf. The water flowing over them, by the reflecting light from its under surface, shows the area over which the air was emanating. The air gradually collected into bubbles and then rose to the surface. The quantity of air which rises is very great—especially from the spiral vessels when wounded in any way. A single stem of one-third of an inch in diameter, containing tubes of a sectional area of not more than one-quarter of this, or say two-tenths of an inch square, even where the leaf is cut off, has been ascertained by experiment to discharge thirty-three cubic inches of air hourly. The velocity with which the column advances must be at the rate of twenty feet an hour.—*Ed. N. Phil. J.*, [2], vii, 323.

9. *Hairs of Urticaceæ.*—The stinging hairs (*stimuli*) of Urticaceæ consist of a single cell, more or less elongated, swollen at its base, where it is sheathed by a layer of epidermal cells, and terminated sometimes by a sharp point, but more commonly by a small rounded pyriform or acuminated knob. This hair becomes broken in the skin, and allows the acrid fluid it contains to flow out. This gives rise to accidents of a more or less severe nature. The severity of the sting depends not on the quantity of fluid which enters the puncture, but rather on its activity. The sheathing or bulbous portion of the hairs varies much in length. Sometimes it exceeds the free portion, as in *Urtica ferox*, one of the species, which gives a most dangerous sting. In some species of Urera and in one or two other genera, the sheathing portion increases much with age, becomes woody, and forms a true prickle or aculeus, analogous to those of the Rose and of some species of Hibiscus.

Glandular hairs, properly so called, are rare among the Urticaceæ. Species of *Fleury* present examples of these hairs, as well as the ribs of the lower surface of *Parietaria communis*, on which we also notice, as in *Forskohlea* and some other genera, hooked or uncinate hairs. The spe-

cies of *Forskohlea* or of *Droguetia* exhibit in different parts of their inflorescence a mass of woolly hairs analagous to those which cover the cotton plant. None of the Urticaceæ have webbed hairs.—*Ibid*, p, 324.

10. *The Complete Writings of Thomas Say on the Conchology of the United States;* edited by W. G. Binney, member of the Academy of Natural Sciences, of Philadelphia, etc. pp. 252, 8vo, with 75 plates. New York: H. Bailliere, 1858.—The republication of the works of our earlier scientific writers, if not constituting an actual advance in science, is certainly as generally useful, and in many cases even more so, than the announcement of new observations. The reprint before us of the results of the conchological labors of the father of American zoology, supplies what has long been needed by those interested in this department, and reflects equal credit upon the editor who has collected them, and the house who have undertaken their publication. The articles now first brought together into one volume, are found chiefly in scientific books and periodicals now out of print or very difficult of access; and the obstacles in the way of reference to them, have deterred or discouraged many a young naturalist from the study of our shells. This remark applies more particularly to our fresh water univalves, and the marine shells of the southern coast; the works of Gould, Binney, and Lea, having done much to elucidate the other divisions. With the volume before us, however, complete as it is both in text and plates, the study of our testaceous mollusks becomes comparatively easy. A little additional bibliographical research, will give the student all that is known on the subject, as the works of the other authors may for the most part be easily obtained.

The descriptions of terrestrial shells are collected together in the first forty pages, but all the others are arranged in the order of their respective dates. So that the genera and families are not grouped together, and sometimes there are remarks on the same species in various parts of the book. But for the convenience of those who would study the species of each genus together, or read at once all that relates to a single species, a full and elaborate index is appended, "to all the generic and specific descriptions of shells of Thomas Say, and to the synonyms used in his writings, with the name, date, volume, page, and figure of the original works containing them." This index would alone be of great use, being the first ever drawn up of Say's writings upon conchology. No attempt is made to complete the synonymy of Say's species, from European works, which now becomes highly desirable.

The plates, seventy-five in number, are mostly printed from the original coppers used by Say. Some of these are remarkable for an accuracy and beauty which is somewhat surprising, when we consider the time and place of their production, (New Harmony, Indiana, 1830). Plate 15, and those from Nicholson's Encyclopedia, (Pl. 69–72,) are fac-similes of the originals. Pl. 75, although prepared by Mr. Say, is now for the first time published. The size of the work is convenient, the text compact, and the printing good, although the typographical errors seem unfortunately numerous.

Extracts from the Address of Prof. Owen, *President of the British Association, at Leeds, Sept.* 22, 1858.—*Athen.*, No, 1613, 394.

We are here met, in this our twenty-eighth annual assembly, having accepted for the present year, the invitation of the flourishing town and firm seat of British manufacturing energy, Leeds, to continue the aim of the Association, which is the promotion of Science or knowledge of the laws of Nature; whereby we acquire a dominion over nature, and are thereby able so to apply her powers as to advance the well-being of society and exalt the condition of mankind. It is no light matter, therefore, the work we are here assembled to do. God has given to man a capacity to discover and comprehend the laws by which His universe is governed; and man is impelled by a healthy and natural impulse to exercise the faculties by which that knowledge can be acquired. Agreeably with the relations which have been instituted between our finite faculties and the phenomena that affect them, we arrive at demonstrations and convictions which are the most certain that our present state of being can have or act upon. Nor let any one, against whose prepossession a scientific truth may jar, confound such demonstrations with the speculative philosophies condemned by the Apostle; or ascribe to arrogant intellect, soaring to religions of forbidden mysteries, the acquisition of such truths as have been or may be established by patient and inductive research. For the most part, the discoverer has been so placed by circumstances,—rather than by predeterminated selection,—as to have his work of investigation allotted to him as his daily duty; in the fulfillment of which he is brought face to face with phenomena into which he must inquire, and the result of which inquiry he must faithfully impart. The advance of natural as of moral truth, has been and is progressive: but it has pleased the Author of all truth to vary the fashion of the imparting of such parcels thereof as He has allotted, from time to time, for the behoof and guidance of mankind. Those who are privileged with the faculties of discovery are, therefore, to be regarded as preördained instruments in making known the power of God, without a knowledge of which, as well as of Scripture, we are told that we shall err. Great and marvellous have been the manifestations of this power imparted to us of late times, not only in respect of the shape, motions and solar relations of the earth, but also of its age and inhabitants.

Geological Time.—In regard to the period during which the globe allotted to man has revolved in its orbit, present evidence strains the mind to grasp such sum of past time with an effort like that by which it tries to realize the space dividing that orbit from the fixed stars and remoter nebulæ. Yet, during all those eras that have passed since the Cambrian rocks were deposited which bear the impressed record of creative power, as it was then manifested, we know, through the interpreters of these "writings on stone," that the earth was vivified by the sun's light and heat, was fertilized by refreshing showers and washed by tidal waves. No stagnation has been permitted to air or ocean. The vast body of waters not only moved, as a whole, in orderly oscillations, regulated, as now, by sun and moon, but were rippled and agitated here and

there successively by wind and storms. The atmosphere was healthily influenced by its horizontal currents, and by ever-varying clouds and vapors rising, condensing, dissolving, and falling in endless vertical circulation. With these conditions of life, we know that life itself has been enjoyed throughout the same countless thousands of years; and that with life, from the beginning, there has been death. The earliest testimony of the living thing, whether shell, crust, or coral in the oldest fossiliferous rock, is at the same time proof that it died. It has further been given us to know, that not only the individual but the species perishes; that as death is balanced by generation, so extinction has been concomitant with creative power, which has continued to provide a succession of species; and furthermore, that as regards the varying forms of life which this planet has witnessed, there has been "an advance and progress in the main." Geology demonstrates that the creative force has not deserted this earth during any of her epochs of time; and that in respect to no one class of animals has the manifestation of that force been limited to one epoch. Not a species of fish that now lives, but has come into being during a comparatively recent period; the existing species were preceded by other species, and these again by others still more different from the present. No existing genus of fishes can be traced back beyond a moiety of known creative time. Two entire orders (Cycloids and Ctenoids) have come into being, and have almost superseded two other orders (Ganoids and Placoids), since the newest or latest of the secondary formations of the earth's crust. Species after species of land animals, order after order of air-breathing reptiles, have succeeded each other; creation ever compensating for extinction. The successive passing away of air-breathing species may have been as little due to exceptional violence and as much to natural law, as in the case of marine plants and animals. It is true, indeed, that every part of the earth's surface has been submerged; but successively, and for long periods. Of the present dry land different natural continents have different Faunæ and Floræ; and the fossil remains of the plants and animals of these continents respectively show that they possessed the same peculiar characters, or characteristic *facies*, during periods extending far beyond the utmost limits of human history. Such, gentlemen, is a brief summary of facts most nearly interesting us, which have been demonstratively made known respecting our earth and its inhabitants. And when we reflect at how late and in how brief a period of historical time the acquisition of such knowledge has been permitted, we must feel that vast as it seems, it may be but a very small part of the patrimony of truth destined for the possession of future generations. * * *

Earth's Magnetism.—Magnetism has been studied with two aims: the one, to note the numerical relations of its activity to time and space, both in respect of its direction and intensity; the other, to penetrate the mystery of the nature of the magnetic force. In reference to the first aim, my estimable predecessor adverted, last year, to the fact, that it was in the committee-rooms of the British Association that the first step was taken towards that great magnetic organization which has since borne so much fruit. Thereby it has been determined that there are periodical changes of the magnetic elements depending on the hour of the day, the season of the year, and on what seemed strange intervals of about eleven

years. Also, that besides these regular changes, there were others of a more abrupt and seemingly irregular character—Humboldt's "magnetic storms"—which occur simultaneously at distant parts of the earth's surface. Major-General Sabine, than whom no individual has done more in this field of research since Halley first attempted "to explain the change in the variation of the magnetic needle," has proved that the magnetic storms observed diurnal, annual, and undecennial periods. But with what phase or phenomenon of earthly or heavenly bodies, it may be asked, has the magnetic period of eleven years to do? The coincidence which points to, if it does not give, the answer, is one of the most remarkable, unexpected, and encouraging to patient observers. For thirty years a German astronomer, Schwabe, had set himself the task of daily observing and recording the appearance of the sun's disc, in which time he found the spots passed through periodic phases of increase and decrease, the length of the period being about eleven years. A comparison of the independent evidence of the astronomer and magnetic observer, has shown that the undecennial magnetic period coincides both in its duration and in its epochs of maximum and minimum with the same period observed in the solar spots. * * *

Electric Currents in Animals.—Galvani arranged the parts of a recently mutilated frog so as to bring a nerve in contact with the external surface of a muscle, when a contraction of the muscle ensued. In this suggestive experiment the Italian philosopher, who thereby initiated the inductive inquiry into the relation of the nerve force to electric force, concluded that the contraction was a necessary consequence of the passage of electricity from one surface to the other by means of the nerve. He supposed that the electricity was secreted by the brain, and transmitted by the nerves to different parts of the body, the muscles serving as reservoirs of the electricity. Volta made a further step by showing that under the conditions or arrangements of Galvani's experiments, the muscle would contract, whether the electric current had its origin in the animal body, or from a source external to that body. Galvani erred in too exclusive a reference of the electric force producing the contraction to the brain of the animal: Volta in excluding the origin of the electric force from the animal body altogether. The determination of "the true" and "the constant," in these recondite phenomena, has been mainly helped on by the persevering and ingenious experimental researches of Mateucci and Du Bois Reymond. The latter has shown that any point of the surface of a muscle is positive in relation to any point of the divided or transverse section of the same muscle; and that any point of the surface of a nerve is positive in relation to any point of the divided or transverse section of the same nerve. Mr. Baxter, in still more recent researches, has deduced important conclusions on the origin of the muscular and nerve currents, as being due to the polarized condition of the nerve or muscular fibre, and the relation of that condition to changes which occur during nutrition. From the present state of neuro-electricity, it may be concluded that nerve force is not identical with electric force, but that it may be another mode of motion of the same common force; it is certainly a polar force, and perhaps the highest form of a polar force. * * *

Photography—Electric Telegraph.—Since Niepce, Herschel, Fox Talbot, and Daguerre laid the foundation of Photography, year by year some improvement is made,—some advance achieved, in this most subtle application of combined discoveries in Photicity, Electricity, Chemistry, and Magnetism. Last year Mr. Poitevin's production of plates in relief, for the purpose of engraving by the action of light alone, was cited as the latest marvel of Photography. This year has witnessed photographic printing in carbon by Mr. Pretschi.—Prof. Owen continued by alluding to the application of photography for obtaining views of the moon, of the planets, of scientific and other phenomena. After referring to the discoveries in Electro-magnetism, the lecturer continued—Remote as such profound conceptions and subtle trains of thought seem to be from the needs of every-day life, the most astounding of the practical augmentation of man's power has sprung out of them. Nothing might seem less promising of profit than Oersted's painfully-pursued experiments, with his little magnets, voltaic pile, and bits of copper wire. Yet out of these has sprung the electric telegraph. Oersted himself saw such an application of his convertibility of electricity into magnetism, and made arrangements for testing that application to the instantaneous communication of signs through a distance of a few miles. The resources of inventive genius have made it practicable for all distances; as we have lately seen in the submergence and working of the electro-magnetic cord connecting the Old and the New World. On the 6th of August, 1858, the laying down of upwards of 2,000 nautical miles of the telegraphic cord, connecting Newfoundland and Ireland, was successfully completed; and on that day a message of thirty-one words was transmitted in thirty-five minutes, along the sinuosities of the submerged hills and valleys forming the bed of the great Atlantic. The first message expressed—"Glory to God in the highest: on Earth Peace, Good-will towards Men." Never since the foundations of the world were laid could it be more truly said, "The depths of the sea praise Him!" More remains to be done before the far-stretching engine can be got into full working order; but the capital fact, viz: the practibility of bringing America into electrical communication with Europe has been demonstrated; consequently, a like power of instantaneous interchange of thought between the civilized inhabitants of every part of the globe, becomes only a question of time. The powers and benefits thence to ensue for the human race can be but dimly and inadequately foreseen. * * *

Homology.—After pointing out the distinction between Affinity, which indicates an intimate resemblance, and Analogy, which indicates a remoter one, Prof. Owen continued—The study of homologous parts of a single system of organs—the bones—has mainly led to the recognition of the plan of archetype of the highest primary group of animals, the Vertebrata. The next step of importance will be to determine the homologous parts of the nervous system, of the muscular system, of the respiratory and vascular system, and of the digestive, secretory and generative organs in the same primary group or province. I think it of more importance to settle the homologies of the parts of a group of animals constructed on the same general plan, than to speculate on such relations of parts of animals constructed on demonstratively distinct plans of or-

ganization. What has been effected and recommended, in regard to homologous parts in the Vertebrata, should be followed out in the Articulata and Mollusca. In regard to the constituents of the crust or outer skeleton and its appendages in the Articulata, homological relations have been studied and determined to a praiseworthy extent, throughout that province. The same study is making progress in the Mollusca; but the grounds for determining special homologies are less sure in this subkingdom. The present state of homology in regard to the Articulata, has sufficed to demonstrate that the segment of the crust is not a hollow expanded homologue of the segment of the endo-skeleton of a vertebrate. There is as little homology between the parts and appendages of the segments of the Vertebrate and Articulate skeletons respectively. The parts called mandibles, maxillæ, arms, legs, wings, fins, in Insects and Crustaceans, are only "analogous" to the parts so called in Vertebrates. A most extensive field of reform is becoming open to the homologist in that which is essential to the exactitude of his science—a nomenclature equivalent to express his conviction of the different relations of similitude. Most difficult and recondite are the questions in face of which the march of Homology is now irresistibly conducting the philosophic observer. Such, for instance, as the following: Are the nervous, muscular, digestive, circulating and generative systems of organs more than functionally similar in any two primary provinces of the animal kingdom? Are the homologies of entire systems to be judged of by their functional and structural connexions, rather than by the plan and course of their formation in the embryo? It may be doubted if embryology alone is decisive of the question whether homology can be predicated of the alimentary canal in animals of different primary groups or provinces. It is significant, however, of the lower value of embryological characters, to note that the great leading divisions of the animal kingdom, based by Cuiver on Comparative Anatomy, have merely been confirmed by von Baer's later developmental researches. * * *

Parthenogenesis.—John Hunter first enunciated the general proposition that "the propagation of plants depended on two principles, the one that every part of a vegetable is 'a whole,' so that it is capable of being multiplied as far as it can be divided into distinct parts; the other, that certain of those parts become reproductive organs, and produce fertile seeds." Hunter also remarked, that "the first principle operated in many animals which propagate their species by buds or cuttings;" but that, whilst in animals, it prevailed only in "the more imperfect orders," it operated in vegetables "of every degree of perfection." The experiments of Trembley on the fresh water polyp, those of Spalanzani on the Naids, and those of Bonnet on the Aphides, had brought to light the phenomena of propagation by fission, and by gemmation or buds, external and internal, in animals, to which Hunter refers. Subsequent research has shown the unexpected extent to which Hunter's first principle of propagation in organic being prevails in the animal division. But the earliest formal supercession of Harvey's axiom, "*omne vivum ab ovo*," appears to be Hunter's proposition of the dual principle above quoted. The experiments of Redi, Malpighi and others had progressively contracted the field to which the "*generatio æquivoca*" could with any plausibility be

applied. The stronghold of the remaining advocates of that old Egyptian doctrine was the fact of the development of parasitic animals in the flesh, brain and glands of higher animals. But the hypothesis never obtained currency in this country; it was publicly opposed in my 'Hunterian Lectures,' by the fact of the prodigious preparation of fertile eggs in many of the supposed spontaneously developed species; and in then suggesting that the *Trichina spiralis* of the human muscular tissue might be the embryo of a larger worm in course of migration, I urged that a particular investigation was needed for each particular species.

Among the most brilliant of recent acquisitions to this part of Physiology, have been the discoveries which have resulted from such special investigations. Kuchenmeister and von Siebold have been the chief laborers in this field. After noticing some of the results of those labors, Prof. Owen said,—Since the time when it was first discovered that plants and animals could propagate in two ways, and that the individual developed from the bud might produce a seed or egg, from which also an individual might spring capable of again budding,—since this alternating mode of generation was observed, as by Chamisso and Sars, in cases where the budding individual differed much in form from the egg-laying one—the subject has been systematized and generalized, with an attempt to explain its principle and greatly advance, especially and in a highly interesting manner, in von Siebold's late treatise, entitled 'Wahre Parthenogenesis bei Schmeterlingen und Bienen,' in which the virgin production of the male or drone-bee is demonstrated. Von Siebold, having subjected to the closest microscopic scrutiny and experiment the conclusion to which the practical Bee-master Dzierzon had arrived, relative to the cause of queen-bees with crippled wings producing a swarm exclusively of drones, has demonstrated that the male bee is produced from an egg which has been subjected to no influence save that of the maternal parent; whilst such egg, if impregnated, would have produced a female or working bee. The now well-investigated phenomena of parthenogenesis in Hydrozoa have resulted in showing, as in the analogous case of Entozoa, that animals differing so much in form as to have constituted two distinct orders or classes, are really but two terms of a cycle of metagenetic transformations—the acalephan Medusa being the sexual locomotive form of the agamic rooted budding polyp, just as the cestoid tænia is of the cystic hydatid. In Hydrozoa (hydroid polyps or sertularians) the young are propagated, as in plants, by "buds," and also, as in most plants, by "germs" or "seeds:" these latter are contained in "germ-sacs" projecting from the outer surface, which is another analogy to the flowering parts of plants. The first acquaintance with these marvels excited the hope that we were about to penetrate the mystery of the origin of different species of animals; but as far as observation has yet extended, the cycle of changes is definitely closed. And, since one essential step in the series is the fertilized seed or egg, the Harveian axiom, "*omne vivum ab ovo*," if metagenetic phases be ascribed to one individual, may be still predicated of all organisms which bear the unmistakable characters of plants or of animals. The closest observations of the subjects of these two kingdoms most favorable to clear insight into the nature of their beginning, accumulate evidence in proof of the essen-

tial first step being due to the protoplasmic matter of a germ-cell and sperm-cell; the former pre-existing in the form of a nucleus or protoplast, the latter as a granulose fluid. In flowering plants it is conveyed by the pollen-tube, in animals and many flowerless plants, by locomotive spermatozoids. The changes of form which the representative of a species undergoes in successive agamically propagating individuals are termed the "metagenesis" of such species. The changes of form which the representative of a species undergoes in a single individual, is called the "metamorphosis." But this term has practically been restricted to the instances in which the individual, during certain phases of the change, is free and active, as in the grub of the chaffer, or the tadpole of the frog, for example. In reference to some supposed essential differences in the metamorphoses of insects, it had been suggested that stages answering to those represented by the apodal and acephalous maggot of the Diptera, by the hexapod larva of the Carabi, and by the hexapod antenniferous larva of the Meloe, were really passed through by the orthopterous insect, before it quitted the egg. Mr. Andrew Murray has recently made known some facts in confirmation of this view. He had received a wooden idol from Africa, behind the ears of which a Blatta had fixed its egg-cases, after which the whole figure had been rudely painted by the natives, and these egg-cases were covered by the paint. No insect could have emerged without breaking through the case and the paint; but both were uninjured. In the egg-cases were discovered, 1st, a grub-like larva in the egg; 2d, a cocoon in the egg containing the unwinged, imperfectly developed insect; 3d, the unwinged, imperfectly developed insect in the egg, free from the cocoon, and ready to emerge. * * *

Geographical and Geological Distribution of Species.—Observations of the characters of plants have led to the recognition of the natural groups or families of the vegetable kingdom, and to a clear scientific comprehension of that great kingdom of nature. This phase of botanical science gives the power of further and more profitable generalizations, such as those teaching the relations between the particular plants and particular localities. The sum of these relations, forming the geographical distributions of plants, rests, perhaps at present necessarily, on an assumption, viz: that each species has been created, or come into being, but once in time and space; and that its present diffusion is the result of its own law of reproduction, under the diffusive or restrictive influence of external circumstances. These circumstances are chiefly temperature and moisture, dependent on the distance from the source of heat and the obliquity of the sun's rays, modified by altitude above the sea-level, or the degree of rarefaction of the atmosphere and of the power of the surface to wastefully radiate heat. Both latitude and altitude are further modified by currents of air and ocean, which influence the distribution of the heat they have absorbed. Thus large tracts of dry land produce dry and extreme climates, while large expanses of sea produce humid and equable climates. Agriculture affects the geographical distribution of plants, both directly and indirectly. It diffuses plants over a wider area of equal climate, augments their productiveness, and enlarges the limits of their capacity to support different climatal conditions. Agriculture also effects local modifications of climate. Certain species of plants re-

quire more special physical conditions for health; others more general conditions; and their extent of diffusion varies accordingly. Thus the plants of temperate climates are more widely diffused over the surface of the globe, because they are suited to elevated tracts in tropical latitudes. There is, however, another law which relates to the original appearance, or creation, of plants, and which has produced different species flourishing under similar physical conditions, in different regions of the globe. Thus the plants of the mountains of South America are of distinct species, and for the most part of distinct genera, from those of Asia. The plants of the temperate latitudes of North America are of distinct species, and some of distinct genera from those of Europe. The Cacteæ of the hot regions of Mexico are represented by the Euphorbiaceæ in parts of Africa having a similar climate. The surface of the earth has been divided into twenty-five regions, of which I may cite as examples that of New Zealand, in which Ferns predominate, together with generic forms, half of which are European, and the rest approximating to Australian, South African, and Antarctic forms; and that of Australia, characterized by its Eucalypti and Epacrides, chiefly known to us by the researches of the great botanist, Robert Brown, the founder of the Geography of Plants.

Organic Life in its animal form is much more developed and more variously in the sea, than in its vegetable form. Observations of marine animals and their localities have led to attempts at generalizing the results; and the modes of enunciating these generalizations or laws of geographical distribution are very analogous to those which have been applied to the vegetable kingdom, which is as diversely developed on land as the animal kingdom in the sea. The most interesting form of expression of the distribution of marine life, is that which parallels the perpendicular distribution of plants. Edward Forbes has expressed this by defining five bathymetrical zones, or belts of depth, which he calls,—1, Littoral; 2, Circumlittoral; 3, Median; 4, Infra-median; 5, Abyssal. The life-forms of these zones vary, of course, according to the nature of the sea-bottom; and are modified by those primitive or creative laws that have caused representative species in distant localities under like physical conditions,—species related by analogy. Very much remains to be observed and studied by naturalists in different parts of the globe, under the guidance of the generalizations thus sketched out, to the completion of a perfect theory. But in the progress to this, the results cannot fail to be practically most valuable. A shell or a sea-weed, whose relations to depth are thus understood, may afford important information or warning to the navigator. To the geologist, the distribution of marine life according to the zones of depth, has given the clue to the determination of the depth of the seas in which certain formations have been deposited. Had all the terrestrial animals that now exist diverged from one common centre within the limited period of a few thousand years, it might have been expected that the remoteness of their actual localities from such ideal centre would bear a certain ratio with their respective powers of locomotion. With regard to the class of Birds, one might have expected to find that those which were deprived of the power of flight, and were adapted to subsist on the vegetation of a warm or temperate latitude, would still be met with more or less

associated together, and least distant from the original centre of dispersion, situated in such a latitude. This, however, is not only not the case with birds, but is not so with any other class of animals. The Quadrumana, or order of apes, monkeys and lemur, consist of three chief divisions—Catharines, Platyrhines, and Strepsirhines. The first family is peculiar to the "Old World;" the second to South America; the third has the majority of its species and its chief genus, (Lemur,) exclusively in Madagascar. Out of twenty-six known species of Lemuridæ, only six are Asiatic, and three are African. Whilst adverting to the geographical distribution of Quadrumana, I would contrast the peculiarly limited range of the orangs and chimpanzees with the cosmopolitan powers of mankind. The two species of orang (Pithecus) are confined to Borneo and Sumatra; the two species of chimpanzee (Troglodytes) are limited to an intertropical tract of the western part of Africa. They appear to be inexorably bound by climatal influences regulating the assemblage of certain trees and the production of certain fruits. Climate rigidly limits the range of the Quadrumana latitudinally; creational and geographical causes limit their range in longitude. Distinct genera represent each other in the same latitudes of the New and Old Worlds; and also, in a great degree, in Africa and Asia. But the development of an orang out of a chimpanzee, or reciprocally, is physiologically inconceivable.

The order of Ruminantia is principally represented by Old World species, of which 162 have been defined; whilst only 24 species have been discovered in the New World, and none in Australia, New Guinea, New Zealand, or the Polynesian Isles. The camelopard is now peculiar to Africa; the musk-deer to Africa and Asia; out of about fifty defined species of antelope, only one is known in America, and none in the central and southern divisions of the New World. Palæontology has expanded our knowledge of the range of the giraffe; during Miocene or old Pliocene periods, species of Camelopardalis roamed in Asia and Europe. Geology gives a higher range to the horse and elephant kinds than was cognizant to the student of living species only. The existing Equidæ and Elephantidæ properly belong, or are limited to, the Old World; and the elephants to Asia and Africa, the species of the two continents, being quite distinct. The horse, as Buffon remarked, carried terror to the eye of the indigenous Americans, viewing the animal for the first time, as it proudly bore their Spanish conquerer. But a species of Equus, coëxisted with the Megatherium and Megalonyx, in both South and North America, and perished apparently with them before the human period. Elephants are dependent chiefly upon trees for food. One species now finds conditions of existence in the rich forests of tropical Asia; and a second species in those of tropical Africa. Why, we may ask, should not a third be living at the expense of the still more luxuriant vegetation watered by the Orinoco, the Essequibo, the Amazon, and the La Plata, in tropical America? Geology tells us that at least two kinds of elephant (*Mastodon Andium* and *M. Humboldtii*) formerly did derive their subsistence, along with the great Megatherioid beasts, from that abundant source. We may infer that the general growth of large forests, and the absence of deadly enemies, were the main conditions of the former existence of elephantine animals over every part of the globe.

We have the most pregnant proof of the importance of Palæontology in rectifying and expanding ideas deduced from recent zoology of the geographical limits of particular forms of animals, by the results of its application to the proboscidian or elephantine family.

But such retrospective views of life in remote periods, in many important instances, confirm the zoologist's deductions of the originally restricted range of particular forms of mammalian life. The sum of all the evidence from the fossil world in Australia, proves its mammalian population to have been essentially the same in pleistocene times, as now, —only represented, as the Edentate mammals in South America were then represented, by more numerous genera, and much more gigantic species, than now exist.

But Geology has revealed more important and unexpected facts relative to the marsupial type of quadrupeds. In the miocene and eocene tertiary deposits, marsupial fossils of the American genus Didelphys have been found, both in France and England; and they are associated with Tapirs like that of America. In a more ancient geological period remains of marsupials, some insectivorous, as Spalacotherium and Triconodon, others with teeth like the peculiar premolars in the Australian genus Hypsipromnus, have been found in the upper oolite of the Isle of Purbeck. In the lower oolite at Stonesfield, Oxfordshire, marsupial remains have been found having their nearest living representatives in the Australian genera Myrmecobius and Dasyurus. Thus it would seem, that the deeper we penetrate the earth, or, in other words, the further we recede in time, the more completely we are absolved from the present laws of geographical distribution. In comparing the mammalian fossils found in British pleistocene and pliocene beds, we have often to travel to Asia or Africa for their homologues. In the miocene and eocene strata some fossils occur which compel us to go to America for the nearest representatives. To match the mammalian remains from the English oolitic formations, we must bring species from the Antipodes. These are truly most suggestive facts. If the present laws of geographical distribution depend, in an important degree, upon the present configuration and position of continents and islands, what a total change in the geographical character of the earth's surface must have taken place since the "Stonesfield slate" was deposited in what now forms the county of Oxfordshire! These and the like considerations from the modifications of geographical distribution of particular forms or groups of animals, warn us how inadequate must be the phenomena connected with the present distribution of land and sea to guide to the determination of the primary ontological divisions of the earth's surface. Some of the latest contributions to this most interesting branch of natural history have been the result of endeavors to determine whether, and how many, distinct creations of plants and animals have taken place. But, I would submit that the discovery of two portions of the globe, of which the respective Faunæ and Floræ are different, by no means affords the requisite basis for concluding as to distinct acts of creation. Such conclusion is associated, perhaps unconsciously, with the idea of the historical date of creative acts: it pre-supposes that the portion of the globe so investigated by the botanist and zoologist has been a separate and primitive creation,—

that its geographical limits and features are still in the main what they were when the creative fiat went forth. But geology has demonstrated that such is by no means the case with respect to the portions of dry land now termed continents and islands. The incalculable vistas of time past into which the same science has thrown light, are also shown to have periods during which the relative positions of land and sea have been ever changing.

Already the directions, and to a certain extent the forms of the submerged tracts that once joined what now are islands to continents, and which once united now separate or nearly disjoined continents by broad tracts of continuity, begin to be laid down in geological maps, addressing to the eye such successive and gradually progressive alterations of the earth's surface. These phenomena shake our confidence in the conclusion, that the Apteryx of New Zealand and the Red-grouse of England were distinct creations in and for those islands respectively. Always, also, it may be well to bear in mind that by the word "creation" the zoologist means "a process he knows not what." Science has not yet ascertained the secondary causes that operated when "the earth brought forth grass, and herb yielding seed after his kind," and when "the waters brought forth abundantly the moving creatures that hath life." And supposing both the fact and the whole process of the so-called "spontaneous generation" of a fruit-bearing tree, or of a fish, were scientifically demonstrated, we should still retain as strongly the idea, which is the chief of the "mode" or "group of ideas" we call "creation," viz: that the process was ordained by, and had originated from, an all-wise and powerful First Cause of all things. When, therefore, the present peculiar relation of the Red-grouse (*Tetrao scoticus*) to Britain and Ireland—and I cite it as one of a large class of instances in Geographical Zoology—is enumerated by the zoologist as evidence of a distinct creation of the bird in and for such islands, he chiefly expresses that he knows not how the Red-grouse came to be there and there exclusively; signifying also by this mode of expressing such ignorance, his belief that both the bird and the islands owed their origin to a great first Creative Cause. And this analysis of the real meaning of the phrase "distinct creation," has led me to suggest whether, in aiming to define the primary zoological provinces of the globe, we may not be trenching upon a province of knowledge beyond our present capacities; at least in the judgment of Lord Bacon, commenting upon man's efforts to pierce into the "dead beginnings of things."

Extinction of Species.—On the few occasions in which I have been led to offer observations on the probable cause of the extinction of species, the chief weight has been given to those gradual changes in the conditions of a country affecting the due supply of sustenance to animals in a state of nature. I have also pointed out the characters in the animals themselves calculated to render them most obnoxious to such extirpating influences; and on one occasion I have applied the remarks to the explanation of so many of the larger species of particular groups of animals having become extinct, whilst smaller species of equal antiquity have remained. In proportion to its bulk is the difficulty of the contest which, as a living organized whole, the individual of such species

has to maintain against the surrounding agencies that are ever tending to dissolve the vital bond and subjugate the living matter to the ordinary chemical and physical forces. Any changes, therefore, in such external agencies as a species may have been originally adapted to exist in, will militate against that existence in a degree proportionate, perhaps in a geometrical ratio, to the bulk of the species. If a dry season be gradually prolonged, the large mammal will suffer from the drought sooner than the small one: if such alteration of climate affect the quantity of vegetable food, the bulky herbivore will first feel the effects of stinted nourishment; if new enemies are introduced, the large and conspicuous quadruped or bird will fall a prey, while the smaller species conceal themselves and escape. Smaller animals are usually also more prolific than larger ones. "The actual presence, therefore, of small species of animals in countries where larger species of the same natural families formerly existed, is not the consequence of any gradual diminution of the size of such species, but is the result of circumstances which may be illustrated by the fable of the 'Oak and the Reed;' the smaller and feebler animals have bent and accommodated themselves to changes which have destroyed the larger species." No doubt the type-form of any species is that which is best adapted to the conditions under which such species at the time exists; and as long as those conditions remain unchanged, so long will the type remain; all varieties departing therefrom being in the same ratio less adapted to the environing conditions of existence. But, if those conditions change, then the variety of the species at an antecedent date and state of things will become the type-form of the species at a later date, and in an altered state of things. Observation of animals in a state of nature is required to show their degree of plasticity, or the extent to which varieties do arise: whereby grounds may be had for judging of the probability of the elastic ligaments and joint-structures of a feline foot, for example, being superinduced upon the more simple structure of the toe with the non-retractile claw, according to the principle of a succession of varieties in time. Observation of fossil remains is also still needed to make known the ante-types, in which varieties, analogous to the observed ones in existing species, might have occurred, so as to give rise ultimately to such extreme forms as the Giraffe, for example.

Man.—The aboriginal laws of the geographical distribution of plants and animals, have been modified from of old by geological and the concomitant climatal changes; and much more by man since his introduction upon the globe. The serviceable plants and animals which he has carried with him in his migrations have flourished and multiplied in lands the most remote from the habitats of the aboriginal species. Man has, also, been the most potent and intelligible cause of the extirpation of species within historic times. He alone, with one of the beasts which he has domesticated—the dog—is cosmopolitan. The human species is represented by a few well-marked varieties; and there is a certain amount of correspondence between their localities and general zoological provinces. But with regard to the alleged conformity between the geographical distribution of man and animals, which has of late been systematically enunciated, and made by Agassiz, in Gliddon and Nott's 'Va-

rieties of Mankind,' the basis of deduction as to the origin and distinction of the human varieties, many facts might be cited, affecting the conformity of the distribution of man with that of the lower animals and plants, as absolutely enunciated in some recent works. Nor can we be surprised to find that the migratory instincts of the human species, with the peculiar endowment of adaptiveness to all climates, should have produced modifications in geographical distribution to which the lower forms of living nature have not been subject. Ethnology is a wide and fertile subject, and I should be led far beyond the limits of an inaugural discourse were I to indulge in an historical sketch of its progress.

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IV. ASTRONOMY.

1. *Fifty-fourth and fifty-fifth Asteroids.*—On the 10th of September, 1858, another asteroid was discovered by Mr. H. Goldschmidt at Paris, and the same night a new asteroid was also detected by Mr. George Searle, assistant at the Dudley Observatory, Albany, N. Y. It remains to be seen which of these two asteroids was first discovered in absolute time.

2. *Fourth Comet of* 1858.—A telescopic comet was discovered, May 21st, 1858, by Dr. Bruhns, at Berlin. It appeared in the comet-seeker like a star of the 7th magnitude, with a tail about half a degree in length.

3. *Fifth Comet of* 1858.—The great comet of 1858 was discovered at Florence, on the 2d of June, by Mr. Donati. Owing to its great distance from the earth and the slowness of its geocentric motion, for some time computors were greatly perplexed in determining correct elements of its path. It soon, however, became apparent that it was a comet of remarkable magnitude, and in accordance with prediction, on the 19th of July it surpassed the average of telescopic comets.

The first traces of a tail were not noticed until the 20th of August—on the 29th it was visible to the naked eye, and a train of two degrees in length could be traced with the comet-seeker. For a short time it was visible to us, both morning and evening; it continued to increase in size and brilliancy up to the second week in October, it was nearest to the earth on the 10th of October, and for several evenings the tail extended more than forty degrees, and on one or two occasions it was traced even to sixty degrees.

The telescope of the Observatory of Harvard College revealed a series of extraordinary phenomena in the region contiguous to the nucleus. On the 20th of September a crescent-shaped outline, obscure and very narrow, was seen interposed, like a screen, between the nucleus and the sun; within this, instead of a softly blended nebulous light, indicative of an undisturbed condition of equilibrium, the fiery mass was in a state of apparent violent commotion. On the 23d two dark outlines were traced more than half way round the nucleus; on the next evening still another, each of these was evidently the outer boundary of a luminous envelope,

the brightest being that nearest the nucleus. On the 25th, four envelopes were seen, and many others have subsequently been formed, almost under the eye of the observer, their motion of projection from the nucleus being evident from night to night. Their process of formation became at last so familiar, that their appearance was on several occasions actually predicted from the condition of the nucleus just before each was thrown off.

A close scrutiny of the tail with the naked eye revealed many curious features scarcely less interesting. The observers at Cambridge were favored with an unusually large proportion of clear evenings during the most important part of the comet's apparition. The observations and measurements are now in process of reduction. W. C. B.

Donati's comet is apparently new to science. Mr. Jas. C. Watson, of the Ann Arbor Observatory, Michigan, furnished the following parabolic elements, Aug. 25, 1858, in Gould's Astron. Jour. No. 116, viz:—

Time of perihelion passage, 1858, Sept. 29·794381, Wash. m. t.		
Longitude of perihelion, -	36° 20′ 11″·5	} M. eqx.
" " asc. node, -	165 15 49 ·7	} 1858·0
Inclination, - - -	63 3 6 ·0	
Log. of perih. distance, -	9·763374	
Motion, - - - -	retrograde.	

In a communication dated October 2, and published in Gould's Astron. Jour. No. 117, Mr. Watson states that these elements well represent the observations up to the middle of September. After that the discordances between the observed and computed places were considerable, and he therefore prepared, from normal places, for June 11, Aug. 18, and Sept. 25, the following system of elliptic elements. These give a period of revolution of 2415 years, which is necessarily quite uncertain:—

Time of perihelion passage, 1858, Sept. 29·736355, Wash. m. t.		
Long. of perihelion, - -	36° 13′ 6·2	} M. eqx.
" " asc. node, - -	165 19 11·8	} 1858·0
Inclination, - - -	63 1 27·9	
Angle of excentricity, -	85 24 22·6	
Excentricity, - - -	0·996787	
Log. semi-axis major, -	2·255279	
" perih. dist. - - -	9·762303	

4. *Seventh Comet of* 1858.—The following parabolic elements of the telescopic comet discovered Sept. 5, 1858, at Harvard College Observatory, are furnished by Mr. C. W. Tuttle, assistant, under date of Sept. 14, and published in Gould's Astron. Jour., No. 116:—

Time of perih. passage, 1858, Oct. 17·038128, Greenw. m. t.		
Long. of perihelion, - -	1° 30′ 23″	} M. eqx.
" " asc. node, - -	158 58 0	} 1858·0
Inclination, - - -	21 5 47	
Log. perih. dist. - - -	0·15267	
Motion, - - - -	retrograde.	

5. *Total Solar Eclipse of Sept.* 7, 1858.—It will be remembered that Lieut. Gilliss went to Peru in August last, under the auspices of the

Smithsonian Institution, for the purpose of observing the phenomena of the total eclipse of the sun of Sept. 7, 1858. The means for defraying the cost of the expedition were liberally furnished by William Wheelwright, Esq., of Newburyport, Mass. We are gratified to hear that Lieut. Gilliss accomplished successfully the objects of the expedition, and we await with more than common interest the report of his observations.

6. *Shooting Stars of Aug.* 9–10, 1858.—The annual exhibition of an unusual number of shooting stars about the 10th of August, was this year hid from view at New Haven by clouds. The observations below given show, however, that the August meteoric display appeared this year on the usual scale.

(1.) Mr. Francis Bradley, watching alone, while passing from Davenport, Iowa, to Chicago, Ill., observed shooting stars as follows, viz :—

Aug.	9,	from	10^h	45^m	P. M.	to	12^h	-	-	11
"	"	"	12			"	1	A. M. (10th),		28
"	10,	"	1			"	1 45	"	- -	21
"	"	"	2			"	3 10	"	-	68

Up to about 2 o'clock he could command only about one-sixth part of the sky, and during the last hour about one-fourth or one-fifth. The radiant as usual was in or near Perseus.

(2.) Prof. A. C. Twining, at Cleveland, Ohio, watching alone, observed shooting stars as follows, viz :—

Aug. 10, 0^h 5^m to 2^h 5^m A. M., 56, of which 48 were conformable and 8 unconformable. These observations and the following, were made within 30° of arc all around the radiant.

Aug. 10, 8^h 30^m to 9^h P. M., 11 conformable, and 2 unconformable; the trains long and conspicuous. Radiant had obviously shifted to the West and South.

" 11, 1^h 7^m to 1^h 52^m A. M., 26 conformable and 3 unconformable. Sky overcast in patches, and hazy as yesterday.

" 12, 2^h 15^m to 3^h 15^m A. M., 30 conformable and 3 unconformable. Sky very clear.

" 13, 1^h 30^m to 3^h A. M., 20 conformable and 10 unconformable. Sky clear.

" 14, 3^h 7^m to 4^h 47^m A. M., 5 conformable and 5 unconformable. Sky clear.

On each occasion the place of the radiant was noted, but can not be accurately stated until verified by an exact star chart.

7. *Falling Stars in August.*—M. Coulvier Gravier has reported as follows on the subject of the August shower. During the present year, he obtained at Paris the following results:

	Horary number, mean at midnight.		Horary number, mean at midnight.
July 14 to 17,	3·2	August 6 to 8,	12·4
" 19 to 21,	9·4	" 9 to 11,	39·3
August 1 to 5,	12·9	" 12,	26·0

Comparing the years since observations began, he finds that since 1848, the number has regularly decreased, the number then was 110 in place of 39·3 of this year. Taking the mean for the three years 1849, 1850,

1851, we find it 85·8; for 1852, 1853, 1854, 57; for 1855, 1856, 1857, it is 44·9; and finally for 1858, only 39·3. It is to be said, however, that this result is not confirmed by observations elsewhere, or at least is not evident from them.—*L'Institut*, xxvi, 271, *Aug.* 1858.

8. *Meteoric Stone from near Mainz.*—The analysis of this stone by F. Seelheim (J. f. pr. Chem., lxxiii, 235) afforded, soluble gelatinizing silicate 52·23 per cent, insoluble silicate 39·26 p. c., other ingredients 8·56.

Soluble gelatinizing silicate (52·23 per cent) consisted of $\ddot{S}i$ 15·74, $\dot{M}g$ 16·12, $\dot{N}i$ 2·08, $\dot{F}e$ 18·29 (oxygen ratio of silicates for $\dot{R} : \ddot{S}i = 10·94 : 8·17$).

Insoluble silicate (39·26 per cent) $\ddot{S}i$ 20·96, $\dot{A}l$ 13·49, $\dot{F}e$ 3·60, $\dot{K}$ 1·21 (oxygen ratio for $\dot{R}, \dot{H}, \ddot{S}i = 1 : 6·3 : 10·9$.

Other ingredients (8·56 p. c.) FeS^2 3·86, nickeliferous iron 2·13, $\dot{C}r$ 0·46, $\dot{P}$ 0·60, $\dot{H}$ 1·51, Cu, Sn, Mn, $\dot{C}a$, *traces.*

The stone has the specific gravity 3·44; H.=5; BB. edges rounded. Appearance in part like an altered olivine; color dirty yellowish-brown; granular.

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *The Aquarian Naturalist, a Manual for the Sea Side*; by Thomas Rymer Jones, F.R.S. 524 pp., 12mo, with 8 colored plates. London, 1858. Van Voorst.—This is an excellent work, whether considered as to its literary, scientific or artistic merits. The aquarian naturalist will find it a most agreeable and instructive companion; and all interested in the wonders, beauties and truths of the world of life will read it with pleasure and profit. The author is distinguished among the men of science of England. We cite a few paragraphs from the work:—

"*Arenicola Piscatorum*—'*The Lug.*'—Every visitor to the sea-coast must have remarked certain places on the shore, near low-water mark, almost entirely covered with little pyramids or mounds formed by coils of sand or mud, the '*castings*,' as they are called, of worms. All these little heaps are produced by an animal lurking at a considerable depth beneath the surface, named in scientific language *Arenicola piscatorum*, and known by fishermen, who find in it a valuable bait, as the *Lug-worm* or the *Lug*. There can never be any difficulty in procuring specimens of these worms, if only care be taken to dig deep enough, the spade being driven to the depth of at least a foot and a half into the sand, otherwise the animal will certainly be broken.

When dug up entire, this beautiful Annelidan is found to be about ten inches in length, and in some parts nearly half an inch in thickness, its body being cylindrical, and made up of very numerous segments towards the posterior part. However, it becomes suddenly reduced in size, and assumes quite a different appearance, as if more uniform in structure, and presenting a shagreen surface. A double row of bunches of setæ project from the sides of the animal, and thirteen pairs of beautiful vermilion-colored tufts rise from the back, commencing at about one-third of the length from the anterior extremity; these last-named organs, which constitute the respiratory apparatus, are extremely elegant, and when examined with a simple magnifying-glass resemble arborescent shrubs, the stems, boughs and branches of which are all in lively action.

The diversity of color in this species is very great: of a number collected together, some will be found of a carmine hue, or of a still deeper red, some brownish, and others blackish green, or all these shades are sometimes blended together in the same individual.

Dwelling constantly in the dark, not only deep in the sand, but generally covered by the sea, the Arenicola is extremely impatient of light, and when in confinement continually attempts to penetrate downwards, even when there is no sand in the vessel; but if amply provided with this material, it soon screens itself from view.

The *Arenicola piscatorum* connects the naked with the sedentary Annelida. A viscid secretion exudes from the anterior half of the animal, to which the sand adheres, and hence, when the worm is dug up, this part is generally found to be covered with an imperfect arenaceous tube, within which the movements of the worm are performed with perfect freedom, but which can not be removed entire, on account of its extreme fragility. This tube is, in fact, left behind as the animal progresses, and forms a complete lining for the hole, which, like the brickwork of a well, it supports, and keeps pervious throughout its whole length. The creature is thus enabled to ascend readily to the surface, and the water is admitted freely to the branchiæ.

A few of the anterior rings of the Arenicola progressively diminish in size, and each admits of being completely folded within the ring immediately behind it. Hence, when they are fully retracted, the anterior extremity of the animal appears abruptly truncated; while it is prolonged in the shape of a regular cone when they are projected to an extent just short of developing the mouth. This constitutes its boring apparatus. The rings being retracted, the flat head of the Arenicola is directed against the sand, and then the forcible projection of the cone opens a passage for the rest of the body. The opening thus made would, however, be insufficient, and the delicate branchiæ might be injured while forced through such a narrow passage; but, to avoid this, the animal immediately on completing the penetration distends the penetrating rings very considerably. By the advance of the body the opening thus enlarged is then occupied, and the rings being again received into each other, the cone is ready to be again projected. During the progress of the animal, the glutinous secretion which exudes from it cements together the surrounding sand, and gives that support to the sides of the hole, without which it would immediately fall in.

It is not, however, simply for the purpose of excavating a retreat that the Arenicola thus pioneers beneath the soil—the sand amongst which it works is devoured and swallowed as the worm bores its way: not that the sand itself is nutritive, or can be used as food, but the organic matters mixed up with it—the last scrapings, as we might say, of the platter,—are thus made useful, and become assimilated as the earthy medium traverses the alimentary canal, and it is finally rejected in the form of the sand-coils which betray the retreats of the "lugs" on every sea-beach.

The Arenicola seems to be a favorite article of food to all sorts of marine animals of carnivorous appetite: not the apple of Discord itself stirred up such sanguinary battles, nor was the body of Patroclus more stoutly fought for by the rival Greeks and Trojans than one of these

worms, when offered as the prize of fight among the multifarious combatants ready to claim their portion.

In order to study the mutual hostilities of these warlike races, M. Quatrefages threw a large specimen into a pool a few feet wide. A troop of shrimps at first, scared by the sound, darted away; but these soon rallied, just as the Annelid was about to bury itself in the sand, when one, more daring than the rest, grappled it by its middle. Thus emboldened, others lost no time in prosecuting the attack, and the poor worm was pulled about in all directions, till a full-grown pawn, rushing from behind a tuft of coralline, dispersed his feebler comrades, and appropriated the booty to himself. It was, however, at once seen that he would speedily be forced to share the spoil, for at that very instant there appeared some score of Turbos and small Whelks, who, conscious that a dinner was at hand, all hastened up, evidently for the purpose of participating in the feast. Without any sign of uncertainty or hesitation they moved straight forward toward the anticipated meal, and the worm was soon covered with these predatory mollusks. The fate of the contested prey seemed definitely settled, when a small Shore Crab (*Carcinus Mœnas*), issuing from underneath a stone, soon put to flight the shrimps, and, by dragging off the Arenicola, very nearly upset all the Turbos, who forthwith retreated gladly to their sandy haunts. Then, however, a large edible Crab (*Cancer Pagurus*) appeared upon the scene, and the poor little *Mœnas* was obliged in his turn to beat a retreat, in order to escape out of the reach of the formidable pincers of his stronger kinsman. Still he kept a watchful eye over the dainty morsel which he had once tasted, and taking advantage of a moment when the larger crab was withdrawing from the field from some temporary emotion of alarm, he rapidly seized the long-disputed Arenicola and carried it for safely to some distance from the water's edge, where he might devour it at his ease upon dry ground, and thus put an end to the combat."

Speaking of *star-fishes*, he says:

"In confinement these creatures are almost invariably subject to frightful mutilations. Not only do they lose large portions of their body, or even entire rays, but the whole animal sometimes literally falls to pieces; nay, although to-day you may possess a complete and beautiful specimen, which has behaved itself in a manner perfectly correct and satisfactory, there is no saying but that to-morrow morning you will find nothing left of it but a heap of fragments dispersed through the water. This kind of suicide is a casualty apparently incidental to the whole race, and with some species, amongst which *Luidia fragilissima* stands preëminently conspicuous, it is so generally put in practice, and that upon the slightest occasions, that to procure one in an entire state is almost impossible.

Prof. E. Forbes, often baffled by this suicidal habit, upon one occasion was induced to take special precaution against it; he accordingly provided a bucket of fresh water to receive and kill instantaneously any that might be caught by the dredge, and a very amusing account he gives of the ill-success of the experiment. 'As I expected, a *Luidia* came up—a gorgeous specimen. As it does not generally break up before it is raised above the surface of the sea, cautiously and anxiously I sank my bucket to a level with the dredge's mouth, and proceeded, in the most gentle

manner, to introduce Luidia to the purer element. Whether the cold element was too much for him, or the sight of the bucket too terrific, I know not, but in a moment he proceeded to dissolve his corporation, and at every mesh of the dredge his fragments were seen escaping. In despair I grasped the largest, and brought up the extremity of an arm with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision.'*

We are reminded by the concluding sentence of the preceding facetious quotation, that, in order to explain the allusion made by our late lamented friend to the 'terminating eye and spinous eyelid' of the Star-fish, it will be necessary to say a few words concerning the senses of these extraordinarily gifted creatures. That they do perceive what is going on in the world around them, at least in so far as their own business is concerned, there cannot exist a doubt; nay, that their perceptions are acute and rapid, any one who has witnessed the facility with which they find and devour a bait, or a morsel of food, will readily allow; but how they are enabled to effect this is by no means so easily explained. That it must be by some sense analogous either to smell or vision, seems pretty evident; but where we are to look for their noses or eyes is a problem not of very easy solution. In many species, however, there are found, situated at the extremity of each ray, certain bright red spots, very conspicuous in the living animal, around which the terminal spines cluster, as though for their protection. These red spots are by many eminent naturalists regarded as the eyes of the Star-fish, and the surrounding spines constitute the eyelid above alluded to. How far they are or are not instruments of vision, is a matter still open to dispute, and a question well worthy of solution by any of our readers, whose opportunities enable them to make experiments upon this interesting subject."

2. *On the Application of Electricity in Local Anæsthesis in Tooth Drawing*, (Athen., 1611, p. 334.)—The application of electricity for producing local anæsthesis in tooth drawing, is creating a considerable sensation. The *modus operandi* is thus described by Mr. Kincely Bridgman, of Norwich. The apparatus is simple, and consists principally of the common electro-magnetic machine used in medical electricity, a single cell and pair of plates constituting a Smee's battery, and a small electro-magnetic coil with a bundle of wires for graduating the strength of the current. One end of the thin wire conveying the secondary current is attached to the handle of the forceps, and the other end of it to a metallic handle to be placed in the hand of the patient. The instrument touching the tooth completes the circuit, and the current passes instantaneously. The wire attached to the forceps should be made to pass through an interrupting footboard, so that the continuity of the wire may be made or broken in an instant by a movement of the right foot of the operator. The advantage of this arrangement is, that it allows the instrument to be placed in the mouth without risk of producing a shock in coming in contact with the lips, cheeks, or the tongue, which would interfere with the quiet of the patient. A hole drilled in the end of the left handle of the forceps, and the end of the wire tapered to fit rather tightly allows the substitution of one pair of forceps for another with

* Forbes's British Star-fishes.

scarcely a moment's delay. The importance of this subject is so great that numbers will, doubtless, immediately have recourse to it, so that we may soon expect its real merits to be fully ascertained.

3. *On the Atlantic Cable;* by WILLIAM GRAVATT, Esq., F.R.S., F.R.A.S., (Edinb. Phil. Mag. and Jour., xvii, p. 34.)—I considered this subject, and, as is well known, arrived at my conclusions long ago; and notwithstanding the conclusions I see were come to at the last meeting of the British Association and at other meetings, and notwithstanding the Astronomer Royal's two papers on the subject, I feel that my original conclusions are unshaken.

The subject is of great importance, and I will (if you will allow me) give you as brief an abstract of my ideas as I possibly can.

I have demonstrated (but without a diagram it is almost impossible to give the demonstration) that if a vessel be running in a straight course at any uniform speed whatever, and the cable is being paid out over the stern at the same velocity, then, in the case where the strain tending to break the cable as it leaves the stern is just equal to the weight in water of a portion of the same cable, whose length is the depth of the sea, the cable will be at any instant in the same condition as to tension and pressure as if it were simply lying straight on an inclined plane surface immersed in water; there will be no strain whatever on the particle which happens at any instant to be the bottom particle of the cable, and the cable will therefore sink down in a vertical plane with uniform velocity, and be laid (not stretched) straight along the bottom of the sea without any waste.

Let

α=the angle the cable forms with the horizon.
t=the terminal normal velocity in feet per second, or the velocity of the cable at right angles to its length.
V=the velocity of the ship in feet per second.
w=the weight in pounds of one foot of the cable, in water.
d=diameter of the cable in feet.
D=the depth of the sea in fathoms.
L=length in fathoms, from the stern of the ship to where it touches the bottom of the sea.

Now the resistance expressed in pounds to each foot in length of a rough cylinder moving sideways in sea water is $\cdot 8dv^2$ pretty nearly (d being the diameter in feet, and v the velocity in feet per second).

We must have therefore $w\cos\alpha - \cdot 8dt^2 = 0$, or $t = \sqrt{\frac{w\cos\alpha}{\cdot 8d}}$.

We must also have $V = \frac{t}{\sin\alpha} = \frac{1}{\sin\alpha}\sqrt{\frac{w\cos\alpha}{\cdot 8d}}$, and also $L = D\operatorname{cosec}\alpha$.

Now, taking as an example $w = \cdot 32$ and $d = \cdot 05$, as is pretty nearly the case in the present Atlantic cable, we get

$$\log t = \tfrac{1}{2}(\log 8 + \log\cos\alpha),$$
$$\log V = \tfrac{1}{2}(\log 8 + \log\cos\alpha) - \log\sin\alpha.$$

From whence, taking $\alpha =$ successively 10°, 20°, &c., we get immediately the following Table, which we can easily extend:

Values of α.	Velocity of ship in feet per seconds	Velocity of ship in knots per hour.	Values of L when D is taken unity.	Terminal normal velocity in ft per sec. or values of f.	Tension in pounds on leaving the ship, the depth of the sea being D in fathoms at 2 lbs. to the fathom.	Tension at the bottom.
10°	16·18	9·71	5·76	2·81	2D	0
20	8 02	4·81	2·02	2·74	2D	0
30	5·26	3·16	2·00	2·68	2D	0
40	3·85	2 31	1·56	2·48	2D	0
50	2·96	1 78	1·30	2·27	2D	0
60	2·31	1·39	1.15	2·00	2D	0

Note.—The slip is obviously V vers α in feet per second, giving a resistance (as will be afterwards shown) of ·012 (6 V vers α)$^{1\cdot8}$ pounds per fathom, or ·012 (6 V vers α)$^{1\cdot8}$ L pounds on the whole, which ought in strictness to be subtracted from the weight of D, but which is too small a quantity to be noticed in practice, at least in any cable similar to this.

Now, taking the greatest depth of the sea to which the cable in question is to be exposed at 2000 fathoms, and each fathom to weigh in water $6\times\cdot32=1\cdot92$ lb., say 2 lbs. per fathom, we have 4000 lbs. for the strain on the cable, whatever may be the velocity of the ship; or as the cable is said to break with about $4\frac{1}{4}$ tons or 9500 lbs., the greatest necessary strain in smooth water is about four-tenths the breaking weight.

But if the cable be paid out at a greater velocity than the horizontal velocity of the ship, the cable will be (so to speak) slipping down the supposed inclined plane, and we must, in that case, find the resistance due to that slipping velocity.

Now this resistance is not exactly as the square of the velocity, nor is it indeed exactly as the diameter of the cable.

Upon the whole, I consider from a comparison of experiments, principally those of Colonel Beaufoy, that when the velocity in knots per hour is v, the resistance in pounds per fathom will, for the cable here supposed, be nearly enough represented by $\cdot012v^{1\cdot8}$.

For the sake of brevity I shall take only the example of this cable at an angle of 20°, where the velocity is, we see, 4·8 knots per hour. Now, taking the depth of the sea at 2000 fathoms, we have $L=D\ \mathrm{cosec}\ \alpha=2000\times2\cdot92=5840$ fathoms.

Taking, for example, the slipping velocity of the cable equal to the velocity of the ship, or paying out twice the necessary length of cable, we find for a slipping velocity of 4·8 knots per hour, a resistance of about ·2 lb. per fathom, or the total slipping resistance of the cable 1168 lbs., by which amount the strain on the cable at the ship's stern will be reduced, or the greatest strain will be $4000-1168=2832$ lbs., or to reduce the strain little more than one-fourth, we should at this velocity have to waste half the cable. Again, a waste of one knot of cable per hour, or a little more than 20 per cent of the cable, would only reduce the strain about 70 lbs.

From the above, it appears that we are not able materially to reduce the strain upon the cable without occasioning excessive waste, unless at 'Leviathan' speed.

Now if, on the other hand, we increased the tension of the cable beyond that due to the simple depth of the sea, the cable would form a curve

concave to the horizon, and we might find the form of this curve when the strain was 2D, 3D, or any multiple whatever of D; but it would be so very bad engineering to *stretch* or *strain* a cable over the bottom of the sea, when we ought, on the other hand, really to allow waste (according to circumstances) to sink into its irregularities, that although I have considered this state of the cable, I think it practically necessary to observe only, that if from any accident the paying out of the cable is obliged to be discontinued, then, in order to avoid a catenarian strain that might be fatal, the motion of the ship should instantly be reversed, and if in very deep water she should run back until the cable hung vertically, or nearly so, a distance which is expressed by $D-L \operatorname{vers} \alpha$ or $D\left(1-\frac{\operatorname{vers} \alpha}{\sin \alpha}\right)$.

A cross current could only curve the free part of the cable sideways without adding to the strain, or occasioning waste, as we readily see if we recur to the idea of the cable lying upon the supposed inclined plane surface; for although we made it curve in any manner by pressing against it sideways, it would, as before, be prevented from slipping down by the weight of a portion of the same cable, whose length was the perpendicular height of the plane.

I may just remark, that if the ship moved with an accelerated velocity, the cable would form a curve with the convexity upwards, and on the other hand, if she moved with a retarded velocity, the cable would form a curve with the convexity downwards.

With a brake-apparatus properly contrived and worked by practised *seamen*, the sending and pitching of the vessel in moderate weather ought not materially to increase the strain on the cable, and the nearer the brake-apparatus can be made to approach in its *action* that of (that exquisitely delicate and simple apparatus) the fly-rod and winch when in the hand of a *fisherman*, the more perfect it will be.

Whilst for very great depths it is very proper to consider the means we have, or may find out, of forming efficient cables of small specific gravity, yet, on the other hand, we ought not to forget that in steel we have a material whose modulus of tension is 6,700 fathoms, whilst for iron wire the modulus is only 4,000 fathoms.

The subject is very interesting, and I could go on much further, but that I fear I have already trespassed too much on your valuable space.

4. *On the Submarine Plateaus of the East Indies;* by George Windsor Earl, M. R. A. S., (Jour. Indian Archipelago and Eastern Asia, [2], ii, 278.)—The Banks of Soundings (as they are termed by seamen) which extend from the continents of Asia and Australia towards each other, form very remarkable features in the physical geography of this part of the world, and, as such, became a subject of interest to the author of these papers more than a quarter of a century ago. The investigation which followed, resulted in enabling him to classify the islands of the Indian Archipelago, distinguishing the *Volcanic* bands from the older formations, and there, he thought, the practical utility of the enquiry would end; but, within the last few years, the depths of the ocean have become of interest to others besides seamen and geographers, and the

section-map which accompanies this paper will probably be acceptable to those men of science who are desirous of connecting Australia with the older continents by telegraphic wires. The map was printed nearly two years ago, for the purpose of illustrating a subject in no way connected with electric telegraphs, but in these utilitarian days the speculative must give way to the practical, and the writer will be well satisfied if the paper now produced assists and encourages the enterprise even in a small degree.

The Asiatic Plateau.—The Asiatic Plateau or "Bank of Soundings" extends from the south-eastern extremity of the continent nearly twelve hundred miles in a direct line towards Australia. It is bounded to the west and southwest by the islands of Sumatra and Java, the outer coasts of which are steep-to, shelving off rapidly to a depth which is unfathomable by the ordinary sounding apparatus in use on board ships. Borneo and the southwestern limb of the island of Celebes lie on its eastern verge, and the extremity nearest to Australia is occupied by a group of islands extending from the southern limb of Celebes, of which Salayer and Kalatoa are the principal. The boundary of the plateau to the northeast is not so distinctly defined. It skirts the east coast of Cochin China throughout its length, and extends from it into the China Sea in a southerly direction for a distance of two hundred and fifty miles, when it is lost among the extraordinary cluster of coral reefs which occupies the remainder of the space between the coast of Cochin China and the islands of Borneo and Palawan—unless we assume that this same cluster of coral reefs is formed on a more deeply submerged portion of the plateau, an assumption which is favored by the fact that the southern boundary of the plateau, which extends from the east end of Java to the island of Kalatoa is also skirted by coral reefs, which probably would have formed a "barrier" like that which bounds the Australian plateau in the Pacific, had circumstances been equally favorable to the development of coral formations.

The average depth of the sea over the plateau is from 28 to 30 fathoms, and rarely exceeds 45 fathoms except near the verges where the soundings necessarily become irregular. The bottom is of the same character throughout, except in spots where currents have swept and exposed the granite or iron stone rock, and here the coral insect will generally have established itself. Elsewhere the bottom consists of a clayey mud, mixed with sand and shells, which is soft enough while under water, but when taken up and dried gradually in a mass, hardens to such a degree that it can not be broken up without the aid of a pickaxe.

No traces of volcanic action have yet been detected on any part of the plateau, the rocks and minerals being all connected with the older formations. It is, however, more than probable that the irregularities of surface that are met with near the northeastern verge in the China Sea, and towards its extremity at Kalatoa, will have been produced by the volcanic convulsions that have taken place in the immediate vicinity.

The extreme length of the submarine plateau, measuring from the head of the Gulf of Siam is 1,700 miles, and its greatest breadth about 800 miles.

The Australian Plateau.—The submarine plateau which extends from the north and northwest coasts of Australia, although covering a space

at least equal to that of the Asiatic plateau, never reaches to a greater distance from the coast than 450 miles, and that only at one point. It is bounded on the east by the Great Barrier Reef which rises abruptly from the depths of the Pacific,—on the north by New Guinea, the Aru Islands and Timor Laut,—and on the northwest by Timor and by an irregular line extending from that island to the Northwest Cape of Australia. The Barrier Reef which forms the eastern boundary, is a natural sea-wall of surprising strength and solidity, and doubtless owes its existence in so compact a form to the circumstance of the coral insect only attaining its full development when incessantly washed by the clear waters of the open ocean. In every other respect, the Australian Plateau is identical in its character with that of Asia. The depth of water is of the same average; the nature of the submerged surface of the plateau is precisely similar; and there is the same tendency to coral reefs and other irregularities near the line where the plateau disappears in the depths of the ocean. The general character of the islands included within the area of the plateau is also the same, no recent volcanic formation having as yet been detected.

The Volcanic Gorge.—All the islands of the Indian Archipelago which are not included within the submarine plateaus defined above are of volcanic origin, and the greater number of the larger islands contain volcanoes in a state of activity at the present time. The seas which bound them are unfathomable by the apparatus in ordinary use on board ships, partly owing to the depth of the ocean, and partly to the strength of the currents, which seem to increase in velocity as the sounding lead descends, but this may be merely imaginary. It is certain, however, that there is a constant current setting in from the Pacific Ocean round the northwest end of New Guinea, (partly caused by the easterly trade wind, and partly, perhaps, by the revolutions of the earth from west to east) which can find no other outlet to the Indian Ocean except through the channels which lie between Kalatoa and Timor. These islands are distant apart exactly 180 miles, which may be considered as the width of the Volcanic Gorge at this, its narrowest, part. This space will have to be sounded before a telegraph cable can be laid down with safety, for although I am of opinion, taking as a criterion the slope of the land on each side of the channels between the islands, that the depth of water will never exceed 1000 fathoms, it may possibly be considerably more.

[The map is omitted. A boundary line marking the limits of the Asiatic plateau extends eastward from the northeast cape of Java to Kalatoa, leaving Floris and other islands east of Java in the deep sea south. From Kalatoa, it bends northward to Celebes. The boundary line of the Australian plateau passes around Timor so as to include it, and then westward and northward just north of Timor Laut, to New Guinea at the parallel of 5°.—Eds.]

5. *Alum in China;* by Dr. Macgowan.—About eleven hundred tons of alum have been exported within a short period, chiefly to India. This mineral is largely employed by the Chinese in dyeing and to some extent in paper-making as with us. Surgeons apply it variously after depriving it of its water of crystallization, and in domestic life it is used for precipitating vegetable substances suspended in potable water.

It is used also by the Chinese in a manner peculiar to themselves. Fishermen are usually provided with it, and when they take one of those huge Thizostoma which abound on the coast they rub the animal with the pulverized styptic to give a degree of coherence to the gelatinous mass. Architects employ it as a cement in those airy bridges which span the watercourses. It is poured in a molten state into the interstices of the stones; and in structures not exposed to constant moisture the cohesion is perfect, but in damp situations it becomes a hydrate and crumbles, a fact of which the whole empire was officially informed by the government about thirty years ago. It was discovered that water had percolated into the mausoleum of Kiaking; having been built too near to the mountain side, the alum cement imbibed moisture, segregated and opened the way for to enter the tomb. In those peaceful days such an event was of so great importance as to call forth edicts and rescripts, memorials and reports in succession for several months. The son-in-law of the deceased monarch, to whose care the construction of the edifice had been entrusted, was fined and degraded, and a statesman from Foh-kien acquainted with the properties of alum, was appointed to remove it a short distance from the mountain.

Alum was first introduced into China from the west, and until a comparatively recent period the best kind called sometimes Persian, and at others Roman Alum, was brought from Western Asia. Numerous localities where an inferior article is manufactured, are mentioned in the Pharmacopœia—*viz*: Shan-tung, Shan-se, Kiang-su, Hu-kwang, Sz'-cheun, and also in the southwestern frontier and in Thibet. That from Sz'-chuen, is represented as having the property of converting iron into copper, or of coating iron with copper, by placing the former metal in a solution of rice-liquor and alum the stone of that province. The most recent editions of works on materia medica, contain no reference to the mines in this province, the products of which have surpassed in quality the foreign, and rendered its importation unnecessary. From this and from other circumstances, it is certain that the works which we shall now describe have not been long in operation. They are in the Sung-yang hills bordering on Foh-kien in the district of Ping-yang, Wan-chau prefecture, and in close proximity to Peh-kwan harbor (27° 9′ 10″ N., 120° 32′ 6″ E.)

The locality has been visited by one foreigner only, to whom we are indebted for most of the following particulars. About two months ago he started from Chih-k'i bight in Lannai harbor, to which Ningpo boats resort for this commodity to the northward of Peh-kwan. Three hour's hard walking over a succession of precipitous hills crossed by stone steps and pathways brought him to the mines. Ten alum-making establishments were in operation, which, with the exception of one on a hill opposite, occupied about a mile of the side of a lofty hill. The works were adjacent to the quarries from which the alum-stone seemed to crop out of decomposed rock of the same lithological character. The stones were thrown into a fire of brushwood, where they were burnt with a slight lambent flame, and as they cracked, the fragments were raked out, broken into small pieces, and macerated in vats. Subsequently the disintegrated mineral was thrown with water into a vessel having an iron bottom and sides

of wood, and boiled for a short time. The lixivium was then poured into large reservoirs where it crystallized into a solid mass. Blocks of alum weighing about fifty catties each, were hewn out of the reservoir and carried in this state in bamboo frames, one on each end of a porter's pule to the place of shipment, where it is broken into fragments. When not designed for immediate exportation the blocks are stored away for drying. On reaching the depot the alum is found charged with a double quantity of moisture, the porters being obliged to deliver a certain weight, they slip their burdens in the mountain streams which they pass in the journey.

Judging from the number of laborers engaged in transporting the mineral on the day of our informant's visit, the quantity brought from the works could not be less than eighteen tons. This was represented as less than an average day's work, as labor was in such demand just then for agricultural purposes, that double pay was given;—and aged men, and women, with boys and girls were pressed into the service. Assuming that day's product as a basis for calculation, and making an allowance for rainy days, we may safely estimate the annual supply as between five and six thousand tons. The quantity consumed by the dyers of Ningpo prefecture alone, being nearly twenty-two tons per annum is corroborative of this estimate. The supply is literally inexhaustible. Five dollars and a quarter a ton at the landing, would afford the manufacturer a fair profit. It often fetches much more, as there has been an increasing demand for the article, owing to the greater facilities afforded for exportation from Ningpo in foreign vessels.

6. *Report of the United States Mexican Boundary*, made under the direction of the Secretary of the Interior, by William H. Emory, Major First Cavalry, and United States Commissioner. Vol. I, 4to. Washington, 1857. Executive Document, 34th Congress, 1st Session, No. 108.—This first volume of the Report by Major Emory, on the region along the boundary between Mexico and the United States, has great general interest. The careful descriptions of the plateaus and mountains, and the effective landscape sketches, give the eyes of the traveller to the reader, and will especially attract the physical geographer. The accounts of the natives and the colored sketches, add to our former knowledge on the habits and condition of the Indians. The Geological Reports make up a large part of the volume, and greatly increase its value. There are, first, the Geological Reports of Dr. C. C. Parry, and Assistant Arthur Schott, followed by notes by Major Emory. Then follow the Palæontology and Geology of the boundary by James Hall, and description of Cretaceous and Tertiary Fossils, by T. A. Conrad. This geological part is illustrated by twenty-one 4to plates of fossils from figures drawn by Mr. F. B. Meek, and also by sections and a Geological map of the region west of the Mississippi, by Prof. Hall, assisted by J. P. Lesley.

Eocene shells of the age of the Claiborne formation, were obtained by Mr. Schott in western Texas, at Arroyo Las Minas, between Eagle Pass and Leon.

7. *Prodromus Descriptionis Animalium Evertebratorum*, &c.; by W. Stimpson. Part VI, Crustacea Oxystomata of the North Pacific Expedition. Mr. Stimpson here mentions thirty-one species of Crustacea Oxystomata, including eleven that are new, and the four new genera, *Carcinaspis*, *Cryptocnemus*, *Onychomorpha*, and *Tymolus*.

8. *Chemical Analysis of the Scales of the Striped Bass (Labrax lineatus);* by Mr. JOHN GREEN, (Proc. Bost. Soc. Nat. Hist., vi, p. 374, 1858.) Scales dried at 212° F., afford 45·9 per cent of ash. 100 parts of ash contained of lime 48·36; of magnesia ·99; of phosphoric acid 50·65. This result is identical with the composition of bone ash. The structure of bone is different in the Ganoid fishes from that of any Cycloid or Ctenoid, and confirms the differences already established from the appearances of the scales. The scales of the Amia of the western waters, contain bone corpuscles of the same form and appearance as those of Megalops and Lepidosteus, showing a new analogy of Amia with Ganoid fishes.

9. *On the Rate of Growth of Coral;* by T. LYMAN, (Ib., p. 374.)—Mr. Theodore Lyman, referring to a large fragment of Madrepore Coral, taken from the wreck of a British man-of-war, and which he had exhibited at a recent meeting, said that he had since ascertained that the vessel was lost about the year 1806, or half a century since. The incrustation of the coral around the iron bolt, shows that the diameter of the coral must have been about three inches, and such a shaft, he supposes, would have supported a very high stem, so that the rate of growth might have been perhaps half an inch a year.

10. *First Principles of Physics or Natural Philosophy;* 720 pages, 12mo, with 672 wood-cuts; by BENJAMIN SILLIMAN, Jr., M.D. 1858. Philadelphia, Peck & Bliss.—This text-book was prepared for the use of academies and colleges. It takes up all the departments usually included under the term of Natural Philosophy,—General Properties of Matter, Crystallography, Gravitation, Mechanics, Machines, Hydrostatics, Hydraulics, Acoustics, Heat, Optics, Magnetism, Electricity, Meteorolgy, etc., etc. The topics are treated in a simple manner, without going into abstruse mathematical demonstrations, and with the introduction of whatever of a practical nature would increase its value as a class book. The illustrations are very numerous and well engraved.

11. HANSTEEN.—The University of Christiana has had a medal struck in honor of the 50th anniversary of the professorship of the illustrious Hansteen, one of its members, whose labors, connected especially with terrestrial magnetism, are well known to the world.—*L'Institut, June,* 1858.

12. THE MATHEMATICAL MONTHLY, edited by J. D. Runkle, A.M., 28 pp., small 4to, Cambridge.—The first number of the Mathematical Monthly appeared in October. We can best give an idea of the character of the work, to which we wish great success, by quoting the list of papers:

Note on Decimal Fractions, by Rev. Thomas Hill; Rule for finding the Greatest Common Divisor, by Pliny Earle Chase; Note on Equation of Payments, by G. P. Bond; On the Study of Geometry, by Samuel P. Bates; Demonstration of a Theorem, by Pike Powers; Demonstration of the Pythagorean Proposition, by James Edward Oliver; Note on Napier's Rules, by Truman Henry Safford; Problem, by Prof. Peirce; On the Relation between the States of Minimum and Equilibrium, by John Paterson; Note on Derivatives, by Rev. Thomas Hill; Propositions on the Distribution of Points on a Line, by Prof. Benjamin Peirce; Virtual Velocities, by William Watson; The Prismoidal Formula, by Chauncey Wright; Ovals and Three-Centre Arches, by J. B. Henck.

13. *Black's Atlas of North America.*—A series of twenty Maps, constructed and engraved by JOHN BARTHOLOMEW, with introductory letterpress and a complete index. Edinburgh: Adam & Charles Black, 1856. Demi-folio.—This is an excellent series of maps, neatly engraved and bearing evidence of a careful study of late authorities of North American geography. The grouping of subjects in the maps is judicious and tasteful. The eighteenth map, including California, Oregon, Utah, Washington, New Mexico, Nebraska, Kansas, the Indian Territory, &c., is the best exhibition we have seen of the recent results of explorations in the great central and northern regions of the continent. The price of the atlas is very moderate, (16*s.* sterl.) It is imported in large quantity by Messrs. Little, Brown & Co., of Boston.

14. *Systematic Philosophy, and New Theories of Light and Heat;* by GEORGE FELLOWS HARRINGTON. 108 pp. 8vo. London, 1857.—This is an interesting work, but novel in its views; and so far as it is novel it is at variance with accepted philosophy and what we regard as established truth in chemistry and physics. In an appendix, the author writes as follows on the open polar sea:—

"The open sea, thus discovered and spoken of by Dr. Kane, extending northward from the 80°, proves the existence of a milder climate than is found a few degrees to the south; and as the climate gradually becomes milder northward, probably, from the 75°, there must be a process going on at or near the pole, to generate heat sufficient to affect the temperature of the climate, or water would not be found in a fluid state beyond the 80° of north latitude—a distance of nearly seven hundred English miles from the pole itself. I am at a loss to know what the process can be which produces such heat, unless it is generated by the inflammation of the electricity necessary to feed the flaming *aurora borealis*, as already described. And if the heat there existing is produced by these means, so as to be palpably felt at the distance of seven hundred miles from the centre of the fire, what must it be at the pole itself?"

15. OBITUARY.—*Death of Professor* PARKER CLEVELAND, *of Bowdoin College, Brunswick, Maine.*—This eminent author and teacher has been long known as one of our most distinguished and useful professors of science. He was born in the town of Essex, Mass., January 15, 1780, and was graduated with high honors in Harvard in 1792. Among his distinguished classmates were the Hon. Samuel D. Parker and General William H. Sumner of Jamaica Plain.

Appointed to a tutorship in Harvard in 1803, he held the office only two years, when he accepted the Professorship of Mathematics, Natural Philosophy, Chemistry and Mineralogy in Bowdoin College—four professorships as they are usually arranged in European universities—a heavy load for one man, but it was sustained by him with distinguished ability and success until he was relieved of a part of his duties by the appointment of a Professor of Mathematics; he continued in the other branches until his lamented death October 16, 1858, at the age of 78–9. He was a member of the American Academy of Arts and Sciences, of the Philosophical Society, and of the Maine Historical. He was an honorary member of the Geological Society of London, and of several other learned societies in Europe. In 1824 he received the degree of LL.D. from

Bowdoin College. His moral character was pure, his social dispositions amiable and genial, and his manners affable, warm and winning, especially in his domestic relations.* Professor Cleveland was, for a long course of years, a member of the Congregational Church in Brunswick, and a firm believer in divine revelation.

The senior editor of this Journal first became acquainted with Professor Cleveland in 1814. His reputation for zeal, industry and learning and his success in the cultivation and diffusion of science were even then conspicuous. The department with which his name has been most intimately connected is that of Mineralogy; and his work on this subject gave him deservedly a high reputation throughout the land. The first edition was published at Boston, in 1 vol., 8vo, pp. 670, in 1816, and a second edition, in 2 vols., 8vo, in 1822. It was constructed upon the plan of the Treatise of Alexandre Brongniart of Paris, and like that admirable work it was lucid in statement, rich in facts and attractive in style. A sketch of geology was annexed, as an appendix to mineralogy; for geology was then beginning to be cultivated in this country.

The entire work was received with great approbation. A third edition was announced, as it was much desired, but it did not appear, although the author never relinquished the purpose of revision and republication. It was, doubtless, prevented by his onerous duties in the college and by a severe neuralgic affection, which occasionally visited him with sudden and severe pain in his eyes and head—usually vanishing like a lightning flash as it came. Protracted night studies doubtless aggravated the difficulty.

Professor Cleveland travelled very little; his sphere of original observation in the field was therefore limited, but he made the best use of the opportunities which he enjoyed, and derived much information from an extended correspondence with his scientific friends.

His natural ardor and activity were very great; they were tempered by an excellent judgment and a chastened taste, rendering his writings models of a pure English style. It is much to be regretted that such a man should have been so much withdrawn from original research by the exhausting toil of incessant college duty. Professor Cleveland was well able to have filled a more extended sphere. His talents as a lecturer and teacher were of a high order; his enthusiasm burned bright through half a century and was imparted to his numerous and admiring pupils. He was spared to a good old age, and left a name which will be long honored and revered.

Three eminent professors have departed almost together: Dr. Robert Hare, late professor in Philadelphia, Professor Ira Young, of Dartmouth College, and Professor Cleveland, of Bowdoin. B. S.

Wm. Baird, M.D., F.L.S.: A Cyclopedia of the Natural Sciences, 8vo, Glasgow, 1858.—The Annals and Magazine of Natural History of London speaks of the work as "tolerably satisfactory."

J. Boyd Davies: The Practical Naturalist's Guide, 80 pp. 12mo.—Takes up thoroughly all departments of the subject, with the exception of the stuffing of mammals and birds.

Robert Russell: North America, its Agriculture and Climate, containing observations on the agriculture and climate of Canada, the United States, and the Island of Cuba. 1 vol., 8vo, Edinburg and London; also, Little & Brown, Boston.

* Boston Advertiser.

Hugh Miller: The Cruise of the 'Betsey,' or a Ramble among the Fossiliferous Deposits of the Hebrides: with Rambles of a Geologist, or Ten Thousand Miles over the Fossiliferous Deposits of Scotland. 8vo, 480 pp. Edinburgh, 1858.

Jahresbericht, &c.: annual report on the progress of Chemistry, Physics, Mineralogy and Geology, for 1857. 2 vols. 8vo. Giessen, 1858.

Fr. v. Kobell: Die Mineralogie. Leichtfasslich dargestellt mit Rücksicht auf das Vorkommen der Mineralien, ihre technische Benützung, Ausbringen der Metalle, etc., 2d edit. 8vo, viii. and 248 pp. with 4 plates. Leipzig, 1858, Brandstetter.

Csp. Kuhn: Die Käfer des südbayerischen Flachlandes, analytisch beschrieben, 16mo, viii, and 400 pp., with one lithographic plate. Augsburg, 1858, Kollmann.

F. Lebrun: Description des échantillons recueillis à Essey la Côte. Basalte et ses minéraux. Tufs basaltiques. Roches métamorphiques et leurs minéraux, 8vo, 118 pp. with 5 plates. Nancy, 1858.

Sgm. v. Praun: Abbildung und Beschreibung europaischer Schmetterlinge in systematischer Reihenfolge, 2–6, Heft. 38 pp. 4to, with 20 colored plates. Nürnberg, 1858, Bauer & Raspe.

Proc. Acad. Nat. Sci., Philad. 1858.—p. 134, Locality of Argulus Catostomi; *Slack.*—p. 135, Note on Unio rubiginosus; *Lea.*—On *Salmo Gloverii*, Girard; *E. Harris.*—p. 137, Canker-worm (*Endalimia*) that attacks shade trees in Philadelphia, half destroyed by two species of Ichneumon; *Leidy.*—p. 138, Seven new species of Margaritana and four of Anodonta; *I. Lea.*—p. 139, Explanations of a second edition of a Geological Map of Nebraska and Kansas, &c.; *F. V. Hayden* (noticed in this volume, pp. 276, 404).—p. 159, Prodromus, &c., part vi, including the Crustacea Oxystomata of North Pacific Expedition; *W. Stimpson.*—p. 165, Descriptions of twelve new species of Unionæ and other fresh water shells of the United States; *I. Lea.*—New species of fishes in the Museum of the Smithsonian Institution, collected in connection with the U. S. and Mexican Boundary Survey; *C. Girard.*—p. 171, Mineralogical Notes; *W. J. Taylor.*

Proc. Bost. Soc Nat. Hist. 1858.—p. 371, Habits of the Menobranchus; *S. Kneeland, Jr.*—p. 373, Spermatozoa of Hydra; *H. J. Clark.*—p. 374, Chemical analysis of the Scales of the Striped Bass; *J. Green.*—Rate of Growth of a Madrepore; *J. Wyman.*—p. 376, On the Egg-case of Skates; *J. Wyman.*—p. 379, Description of a new sparrow, Ammodromus Samuelis, from California; *Dr. Abbot.*—p. 380, A form of monstrosity in a pig; *J. Wyman.*—p. 381, New Diatom, *Tryblionella elliptica*; *Stodder.*—p. 382, Biographical notice of J. Müller; *Agassiz.*—p. 383, On the Races of Algeria; *Bodichon.*

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Annales des Sciences Naturelles, including Zoology, Botany, etc. Monthly, 8vo, 38 fr.; the Botanical or Zoological part alone, 25 fr.
Annales de la Soc. Entomologique, quarterly, 8vo, 24 francs.
Annales des Sciences Physiques et Naturelles, monthly, 8vo, (the Scientific part of the Bibliothèque Universelle de Genève.) 25 fr.
Bulletin de la Soc. Botanique, monthly, 8vo, 30 fr.
Revue et Magasin de Zoologie, Guérin, 8vo, monthly, 20 fr.
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